Garage Gyppers—Talking Movies—The Italia Cra

MODERN MECHANICS AND INVENTIONS

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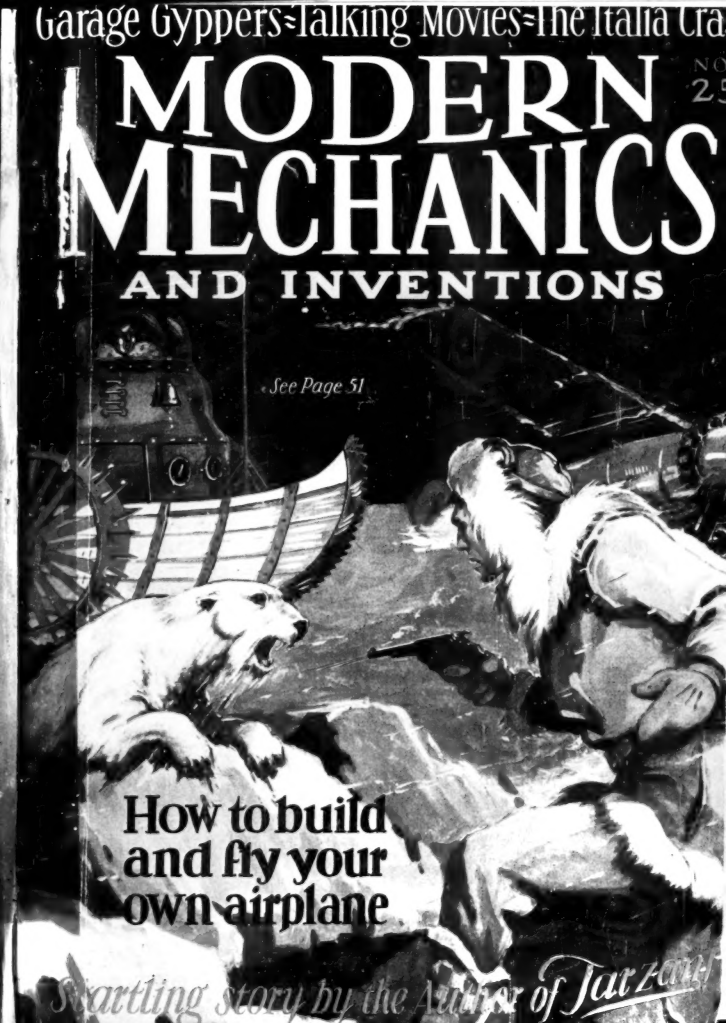

How to build and fly your own airplane

Startling story by the Author of Tarzan

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57 Miles on a Gallon

BUICK
36 Miles on a Gallon

OLDSMOBILE
1300 Miles of Free Gasoline

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SAVED $340
in Gasoline

CHRYSLER
48 Miles Per Gallon

ENDS CARBON
Without Touching the Engine

Who Else Wants to Save Gasoline?

WHAT ILLINOIS CAR OWNERS SAY:

"I purchased one of your Vaporizers several weeks ago and it has proven very satisfactory. I am using it on my Ford Coupe and I am getting approximately 38 miles per gallon of gas. Before I installed the Vaporizer the engine had a carbon knock but that has disappeared now. The motor, I find, works better in several other respects, too."
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"I am getting 30 miles on my Oakland and that's pretty good. I also drove an Oldsmobile 27,000 miles and never had my carbon removed except with a Stransky Vaporizer."
C. G. Betts,
Jackson Plaza Hotel, Chicago.

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Frank Riedinger,
Chicago.

A SOUTH DAKOTA man has discovered an amazing gas-saving invention now installed on over two million cars of every make. Already over ten thousand car owners say it increases gas mileage 25% to 50% . . . cleans out carbon without touching the engine . . . adds more speed and power . . . and saves an astonishing amount of money in gasoline and repair expense. There is a model for every car, truck, tractor or gasoline engine. Anybody can install it in a few minutes.

This invention is based on newly-discovered facts about potential gasoline power that few car owners know about. For example, it is now found that the average man wastes at least 20% to 30% of his gasoline through improper combustion. And many more interesting discoveries, too detailed to mention here.

Read on the left what other car owners say about it. Then accept the inventor's special introductory offer. He will send you samples to test without obligation to buy. If you find it doesn't do for you what it has done for other car owners, he will pay a cash forfeit for the few minutes you've spent in testing it. Don't send a penny now. Simply send your name in coupon below. J. A. Stransky Mfg. Co., P-2620, Stransky Block, Pukwana, S. D.

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P-2620 Stransky Block,
Pukwana, S. D.

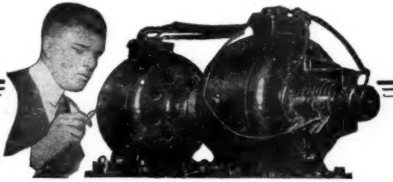
Yes, send me full description of this new way to save gasoline. This request does not obligate me in any way.

My name is.....

Street .....

City ..... State.....

( ) Check here if you want agent's proposition.



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MODERN MECHANICS
AND INVENTIONS

This magazine is not connected or associated with any other magazine of a scientific or mechanical nature.

Vol. I NOVEMBER, 1928 No. 6

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EDITED BY EXPERTS

Listed below are the members of the Modern Mechanics board of editors, all qualified by national reputa- to serve as authorities. They will gladly answer questions from our readers concerning their departments. Address them in care of this magazine, Robbinsdale, Minn.

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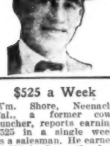
Last Year's Pay Looks Like Small Change to These Men Today!

Here Are Six Men Who Were Formerly Caught in the Hopeless Treadmill of Low-Pay Jobs. Today Every One of Them Reports Earnings from $4,000 up to $10,000 a Year! Right Now—the Same Opportunity That Changed Their Lives So Completely Is Open to YOU! Don't Fail to Read Every Word of This Vital Message!

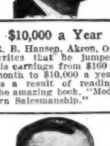


$525 a Week

Wm. Shore, Neenach, Cal., a former cowpuncher, reports earning $525 in a single week as a salesman. He earned $5,000 in 5 months just after completing N. S. T. A. Training.

$10,000 a Year

R. B. Hansen, Akron, O., writes that he jumped his earnings from $160 a month to $10,000 a year as a result of reading the amazing book, "Modern Salesmanship."



$700 a Month

L. O. Halloman, Roswell, New Mex., was a farmer. He wanted to be a salesman and N. S. T. A. helped him. Now he says his earnings are $700 in one month.

$2,500 Increase

As a pattern-maker, the income of Kingsley Rowland, Audubon, N. J., was limited to $1,500 a year. Now he writes that it is about $4,000, thanks to N. S. T. A.

$7,200 a Year

F. J. Walsh, Springfield, Mass., thanks N.S.T.A. training for his sensational rise from $1,000 a year as a clerk to over $7,200 a year.

$4,800 More

F. B. Englehardt, Chattanooga, Tenn., writes that he raised his pay $4,800 after reading "Modern Salesmanship." He credits N. S. T. A. with a great deal of his success.

WHEN a man who has been struggling along in a low-pay job suddenly steps out and starts earning real money—$5,000, $7,500 or $10,000 a year, he usually gives his friends quite a shock. It is hard for them to believe that he is the same man they used to know. Take one of the men whose pictures appear on this page—Kingsley Rowland of New Jersey, for example. His pals in the shop where he was working as a pattern-maker laughed at his ambitions to make more money. But he knew what he wanted, and he set about getting it in the shortest possible way. A remarkable free book, "Modern Salesmanship," opened his eyes to the opportunities in the selling profession. This book proved that Master Salesmen are *made*, not "born"—he told facts and secrets about money-making that were a positive revelation. And best of all, it outlined a simple plan that enables men from all walks of life to quickly reach the top without spending years on the road—without losing a day or a dollar from their present positions!

A Few Weeks—Then Bigger Pay

Rowland seized the opportunity to qualify as a Master salesman, and has richly profited by it. He now reports an increase of $2,500 in his pay, and his future possibilities are unlimited. Some of his former friends perhaps say he was "lucky." He was. But his "luck" lay in his decision to cast his lot with the N. S. T. A. Thousands of other men have been similarly "lucky." Some report increases ranging up to 900%. They have forgotten the days when they were caught in the rut—but they never forget that they owe a great part of their success to N. S. T. A. training.

National Salesmen's Training Association

Dept. S-701, N. S. T. A. Bldg., Chicago, Ill.

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A C Radio tubes, tubes, accessories, parts to Agents, Electrics, television, short wave, boost sales. Get Radio Guide free. 301A tubes 39c Barawik, 5 Canal Sta., Chicago.

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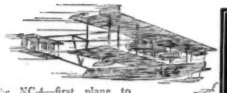
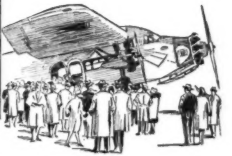


The NC-4—first plane to cross the Atlantic, piloted by Lieut. Walter Hinton. Left Trepassey Bay, Newfoundland, and arrived Lisbon, Portugal; May, 1919.



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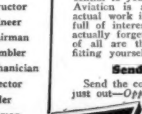

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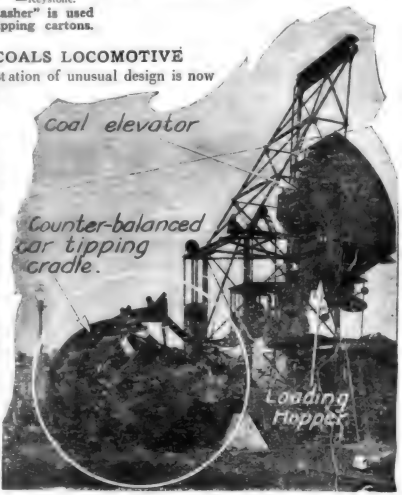

This elaborately counterbalanced device coals locomotive tenders on an English railway.

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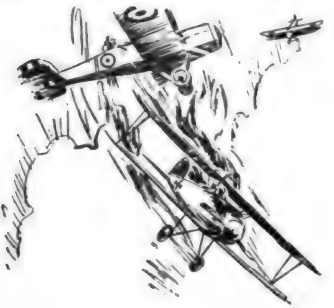

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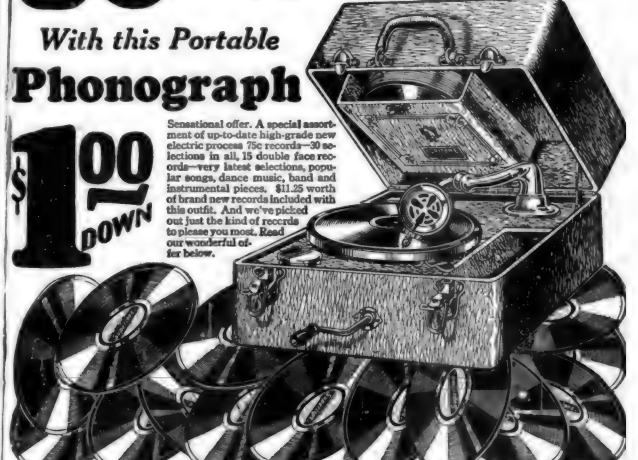

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This Portable Phonograph plays any make of 10-inch disc records and plays two ten-inch records with one winding. Weighs only 17 pounds. Comes in waterproof imitation leather case with hinged lid, closes up like a small suitcase with snap locks and carrying handle (see illustration.) Measures 14½ x 12 x 7½ inches. Records are placed inside of lid and secured so they will not rattle or break. Holds 15 records. Has quiet spring motor, tone arm and reproducer with indestructible diaphragm and wide throat for full sound volume. Outfit includes 15 double face 75c *New Electric Process* records—30 selections. A complete record library without buying a single one! Shpg. weight, packed about 25 lbs.

Order by No. W8824JA; only $1.00 with coupon, $2.60 monthly Total price $26.85.

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FREE CATALOG *of home furnishings sent with or without order. See coupon.*

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Enclosed find $1.00. Ship special advertised Puritone Portable Phonograph with 15 Double Face 75c *New Electric Process* records—30 selections. I am to have 30 days free trial. If I keep the outfit I will pay you $2.60 monthly. If not satisfied, I am to return the phonograph and records within 30 days and you are to refund my dollar and express charges I paid.

Puritone Portable Phonograph and 15 Double Face Records, W8824JA, $26.85

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The Age of Mechanical Marvels

ICE age, stone age, steel age, and now—

The Age of Mechanical Miracles!

And we are living in the midst of it! Within a bare score of years airplanes have developed from frail-powered kites to tremendous craft that span oceans in one jump. Radio has disclosed its miracles in millions of homes, and is reaching out toward the wonders of television.

Minds must be agile to keep pace with this marvelous age. Imagination must be whetted to a fine edge to grasp it all. Even now we can glimpse new wonders that are emerging from the wizard minds of the workers in mechanics—luxurious flying hotels housed in gigantic dirigibles crossing the world's air lanes—motion pictures in colors that reproduce every human sound—rockets that will fly to other planets—engines developing unheard of speeds—radios and telephones that pluck moving-pictures out of the ether.

We must keep pace with the age.

To overlook the wonders about us is to walk blindfolded through the majestic grandeur of a Grand Canyon.

Yet it is manifestly impossible to understand, appreciate, and enjoy these marvels unaided. Thousands of brilliant minds are working out problems, inventions, discoveries all unintelligible to the mind that is trained along other lines.

We need interpreters to explain the swift changes about us. We want to know the why of things without spending a lifetime in delving at intricate sciences.

That is why Modern Mechanics Magazine has been published. It is your interpreter—your teacher, in the task of keeping abreast of the age you are living in.

A board of experts in a dozen great branches of mechanics are the editors. Each a specialist, he translates the language of his profession into universal speech. Your information must be authentic. Only experts can give ungarbled facts.

Fiction of high calibre will entertain you—and stimulate the imagination, opening your mind to new ideas, preparing it for the task of grasping truths more unbelievable than fiction itself.

So we bring you MODERN MECHANICS. We have striven earnestly to prepare a magazine for men and women, boys and girls, that will be valued as a mentor, enjoyed as a playmate, and consulted as a guide along the new trails that are being blazed in human progress.

The Editors

What Caused the

The Italia moored at Spitzbergen before the fatal Polar dash. —M. G. M.

Lieutenant Eielson, who was Captain Wilkins' partner in his Polar flight, advances here the probable causes of the greatest mystery crash in flying history. He will join Wilkins soon to explore the South Pole by air.

WHAT caused the fatal disaster to Col. Umberto Nobile's *Italia* expedition? Why could not the dirigible navigate the polar air? And what was the fate of Dr. Finn Malmgren, Swedish scientist?

These questions have never been satisfactorily answered for the millions who were interested in the venture which cost the lives of so many noted polar explorers. When the crew of the *Italia*, giant dirigible whose arctic trip was sponsored by Mussolini, was wrecked in the ice wastes north of Foyn Island, her survivors when rescued maintained the utmost secrecy as to the cause of the disaster. Their silence has heightened interest in the unexplained mechanical difficulties which might have been responsible for the tragedy. From experience gained in arctic flying I think I can shed some light on their problems.

I have found that difficulties due to cold weather alone are easily overcome. Much is heard in the press about ice forming on the wings of airplanes and on the hulls of airships. It is thought by many that this is what forced the *Italia* down. Personally, I do not think this was the major cause of the accident.

Ice will form only when rain or sleet falls while there is a temperature in the lower altitude a little below freezing. Then, when rain hits the wings, it will freeze immediately. The exploratory flying which Sir Hubert Wilkins and I have done in the arctic during the past three years proved that the *temperature is usually too cold* for ice to form on the machine.

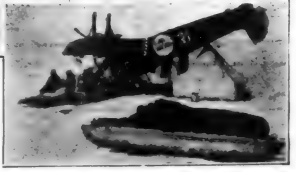
Furthermore, the ice theory has been advanced with such vagueness that I question if it is the primary reason. Ice forms gradually. It seems to me that we would have heard stories of frantic throwing off of

Italia Crash?

By C. Ben Eielson
Who flew over the North Pole

—P. & A.

Crashing on the ice after rescuing Nobile, Lt. Lundborg took this photo. On the wing are Behounek, Biagi, Viglieri and Cecioni, whose leg is splinted on ski poles.



Snapped at the same time, this was the first photo to reach the outside world, being transmitted by telegraph to America. Note Nobile's red tent and collapsible boats.

ballast to keep the machine in the air. No such maneuvers were reported. It was merely said that on the morning of May 25, after having circled the pole, and while on a return flight to the base at Kings Bay, Spitzbergen, that the ship was found to be sinking rapidly. The crash came before the crew was fully warned, wiping off the control gondola and spilling the men on the ice, while six unfortunates, inside the bag, drifted away. The rest were rescued, as the world already knows.

IT IS possible that a contributing cause of the trouble might have been the difficulty of keeping the engines warm, thus lowering their horsepower and limiting the controllability of the rudders and elevators.

At best the ship had a top speed of but 53 miles an hour. This was low—too low for work in windy regions such as the arctic. Should the engines have become less powerful due to cold weather the effect of the control mechanisms, which depend on air resistance, would have been greatly lessened. The dirigible is like the airplane in this respect.

This slowing of the engines is no joke. Capt. Wilkins and I had difficulties keeping our engines warm while in the air. On our flight across the arctic ocean this year in a

temperature of forty-eight below zero (Fahrenheit) our engine temperature would go so low that the engine would sputter and miss.

This was in spite of the fact that our engine was bound with asbestos and shielded from the wind better than any engine that I have ever seen. And, what makes this motor-slowing argument regarding the *Italia* more interesting and plausible, we on our Alaska to Spitzbergen flight experienced no trouble until we had been in the air from five to seven hours, in temperatures around forty below. The same might have happened to the Italian dirigible.

I suppose that at least thirty times on our 2,200-mile hop I had to advance the throttle full and climb steeply to warm the motor. After each climb I would side-slip down to a reasonable altitude and then fly along for half an hour until the temperature had gone down again. Then I would have to repeat the performance. This, by the way, was very uneconomical on our gas supply. We used over seventeen gallons of gas an hour, whereas the trans-Atlantic fliers using the same kind of engine, consumed around eleven. Some manufacturer should design a system of controlling while in flight the temperature of air cooled engines in any range of temperature. Such a system might have altered the fate of the *Italia*.

THE problems and dangers of flying in the Polar regions will be discussed by Lt. Eielson next month in Modern Mechanics. Having pioneered the first air mail in Alaska, Lt. Eielson was a veteran Arctic flier long before his trip with Capt. Wilkins, and is considered a foremost authority.

ANOTHER thing which might have contributed more to the fatal crash than any one other, is, I believe, the fact that they were away from the base for a period long enough to have thrown their altimeter off.

Consider the fact that an altimeter is but an ordinary aneroid barometer graduated to read in feet, instead of inches.

As the altitude rises, the pressure of the air becomes less. This diminution in pressure as the height increases is the reason that a barometer may be graduated to read in feet and tell with reasonable accuracy how high an airship or plane is flying. The dial is set to read zero at the ground before the flight is made. If it were not, the reading would not be accurate, for the barometer pressure at the ground varies greatly from day to day.

After being set at zero, the altimeter would accurately record height as long as the barometric pressure remained the same. However, on the flight of the *Italia*, Kings Bay was left behind in fair weather, which is the same as saying high barometric air pressure existed when the altimeter was adjusted. At the pole weather conditions changed. Storms were encountered on the way home. It is possible that the altimeter adjustments could not be accurately made and consequently might have been out of line with actual pressure conditions at the time of return. The barometer might have read 500 feet more altitude than actually was under the gondola of the *Italia*.

Coupled with this probability, bear in mind two other things. One of these is Nobile's desire to fly low to make observations. On the trip of the dirigible *Norge* across the route Capt. Wilkins and I flew last winter, Amundsen and Lincoln Ellsworth continually remonstrated with Nobile at the low altitude he was maintaining. Finally, in desperation, it developed later, Ellsworth tore Nobile from the controls and took the wheel of the *Norge* himself, climbing the ship to a safer altitude. This penchant for flying low, coupled with the fact that the barometer might have been off key as was the case in so many of the cross mountain air-mail flights which ended by plane crashes against the faces of the mountains, might have been responsible for the *Italia* flying in extreme low altitude, blissfully unaware of the fact.

Then, being caught in one of the currents of air which move up and down in almost vertical direction over the fields of hummock ice, the *Italia* probably was carried downward like a fish in a stream of water, crashing before ballast could be thrown out. This, coupled with the well-known fact that altimeters must be adjusted in relation to

—Wide World.

Lt. Ben Eielson, author of this article, and Capt. George Wilkins, before taking off from Point Barrow for Spitzbergen on their flight over Polar regions where Italia was lost.

true ground pressure to be accurate, may have caused the disaster.

IT HAS been pointed out that dirigibles are extremely sensitive to weight changes. Even huge ships like the Los Angeles, when taking on passengers, do so one at a time. The ship begins to sink, ballast is dumped to compensate for the weight, and when a level keel has been reached again, more men are taken on in the same manner, and more ballast dumped.

A smaller ship like the *Italia* would be even more sensitive to weight changes. If the temperature in the air raised or lowered a few degrees this would affect their altitude materially, due to gas expansion and contraction. If the exhaust condensers, which condense the water in the exhaust gas to compensate for the weight of the fuel burned, should go unwatched, a matter of an extra pail of water would affect the reserve of the ship by an altitude of as much as a hundred feet.

Therefore, with all these conspiring elements tending to defeat his flight, I do not think it fair to criticise Nobile for an accident which happened in a bad storm. He was gambling with chances which he, his men, and every one else who travels in the arctic must accept. No true sportsman would cast reflection on the expedition.

As for the fate of Malmgren? It is my firm conviction Dr. Malmgren died like a hero, urging the others on, as was reported. Men in the air are an honorable lot—there is no greater free lance brotherhood of square shooters than pilots, mechanics, or crews of men who sacrifice all they have in the interests of promoting aviation.

It was no doubt a combination of low altitude flying, inaccurate altimeter, and uncontrollable downward currents which wrecked the *Italia*. Any of these is dangerous. Together they would defeat any man. I think that in the interest of justice it is unfair to criticise the expedition. Think rather of some of the things which might have been said should the flight have proved successful, as it so nearly was!

Is The GARAGE

By Russell Raymond Voorhees

A motor car owner with no mechanical knowledge is helpless in the hands of a garage "gyp."

OWNING and operating an automobile is quite frequently the same sort of a proposition as being married—only worse—it isn't the first cost but the upkeep that upsets the calm and quiet of an otherwise temperate life. The "gyp" car dealer and garage man puts many spikes into what should be a real pleasure—automobiling.

Take Jones as an example. Jones is an office man with more knowledge of mathematics than mechanics. He saved up enough to buy a used car and set out one Saturday afternoon to buy his automobile. He visited several used car dealers but didn't find exactly what he wanted.

"Cap," volunteered one of the dealers as he was about to leave, "I think I can get you a real car for almost a song. I sold a man a car a month ago and he can't pay the notes. It's a 1926 model sedan and a dandy. Will stand you only $195 cash. I will drive around and get you about five o'clock and show you what the car will do."

Promptly at five o'clock the "gyp" tooted his horn and Jones dashed to the door. The "gyp" sat at the wheel of the car.

"Cap, you're in luck," smiled the dealer to Jones as he and his wife came out to take a ride in the car. "Hop in and we'll see how she runs."

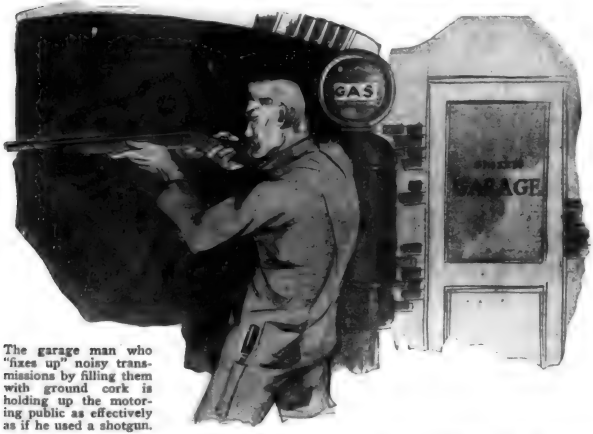
He stepped on the starter. The motor sounded good. The dealer shifted gears quietly. The engine purred and seemed to be full of pep. The clutch and transmission were almost soundless.

Jones decided to buy the car. The "gyp" had driven right in front of a notary's home and so they went in and completed the sale. The dealer took a street car home with his $195. Jones and his wife filled the car with gas and oil and decided to drive around until dark in their new purchase.

Two hours later Jones and his wife rattled back home. The car was running,

Game a HOLDUP?

WHAT do you know about the tricks used by unscrupulous garage men in fleecing the motoring public? If you own a car or expect to own one, you are vitally concerned in this exposure of the garage crook's methods. Mr. Voorhees has written authoritatively of the pitfalls that beset the unwary motorist.



The garage man who "fixes up" noisy transmissions by filling them with ground cork is holding up the motoring public as effectively as if he used a shotgun.

but the body seemed to emit ten thousand different kinds of rattles and noises. And the motor had lost some of its pep; it was overheating. The transmission was groaning. The clutch slipped when changing gear. Everything seemed to be going wrong. Jones put her in the back yard and dropped around to a car dealer friend of his the next morning. The friend came back with Jones, and looked over the buy of the day before.

Tricks of the "Gyp"

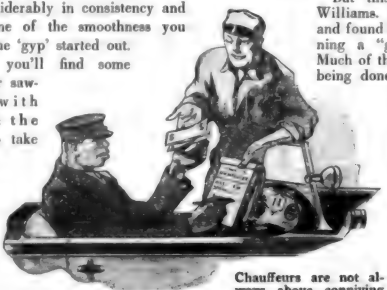
"You're gyped, Jones, and you're gyped badly," said the car dealer friend. "In the first place this is a 1922 model instead of a 1926. All those squeaks you now hear were in it when you bought the car but the man who sold it to you squirted heavy engine oil in all the places and then wiped the outside off. That stopped the noise long enough for him to demonstrate and sell it to you. The lining on your clutch is worn, but he has put some sand on it which made it grip for a time.

He doped the gasoline with ether to give pep to the motor. It's an old trick. About three ounces to five gallons of gas makes a racer of a piece of junk. When you put your own gas into the car you diluted the

Tricks Played on Used Car Buyers

mixture so that there wasn't much pep producing ether left. The water circulation is faulty and your motor is heating. The motometer doesn't show it, I know, but the bottom has been knocked off so that heat won't register.

"The 'gyp' put extra heavy oil in the motor to help it to run smooth. Your oil reduced it considerably in consistency and took away some of the smoothness you noticed when the 'gyp' started out. And I'll bet you'll find some ground cork or sawdust mixed with heavy oil in the transmission to take out the noise there. It's an old trick of 'gyps.' If there is a worn pinion ring gear there the mixture makes it sound like a new one for about twenty miles."



Chauffeurs are not always above conniving with the filling station man, receiving a fifty-fifty split for gasoline paid for but not received.

Jones went back to the office Monday a wiser but poorer man.

Many practices of crooked dealers are illegal, but sometimes they get away with their work even in court. There is the case of the "gyp" who put cotton balls into a transmission in order to take up a slap. In court he was vindicated because he set up the defense that he put the cotton balls in because of their oil content.

There are two classes of garage men to beware of. One class is the used car dealer who fixes up pieces of junk so that they run like new cars—for a while. The other class is the unscrupulous mechanic who tinkers with any kind of a car that is brought to him.

Williams is a case in point. Williams is a man of character in a large mid-western city. He is the owner of a good sized garage which for a time was managed by a man named Clark. The first few months that Clark managed the garage, the profits ran about twice what Williams expected.

"How is it that we are making so much money, Clark?" asked Williams one day as they were going over the records.

"Oh, that's all in the way you run the garage," was Clark's reply.

Swindling the Automobilist

But this didn't satisfy Williams. He investigated and found that he was running a "gyp" garage. Much of the work that was being done was car overhauling. A car owner would bring his car in to be overhauled. Clark would take the rear end down, take out all the insides and carefully clean them and put them away. Then he would take out a lot of old parts that were badly worn and well covered with grease. These would be grouped around the man's car and he would be invited to come in. Clark would show him the worn parts and indicate what was needed to put the car in "apple pie" order. The car owner would O. K. the job. When the owner was gone, Clark would put the cleaned old parts back in and the job was finished. Clark is now out of a job and Williams has a new manager.

The traveling public, America's army of modern gypsies who go touring the country, are easy prey for the "gyp." He knows they are travelers and are not likely to return to his town. He is certain that he can fix them up so that they will get far enough away so that they won't come back.

A car stopped in front of a garage in the South one day after a rain. The motor was missing a bit and the motorist felt it should have attention. All the trouble was

that a connection has become loosened and one of the spark plugs was a little wet. What did the garage proprietor do?

"Your trouble is in your spark plugs," said he. "Better leave the car here for ten or fifteen minutes while I put in new spark plugs."

The motorist agreed and left the car with him. He immediately took out the old spark plugs, washed and wiped them off, painted the tops red and put them back in the engine. He charged them for all new plugs and they went on their way.

Another tin-canner developed a piston slap in his old bus. Sounded too bad to let go so he stopped beside the roadside—at a "gyp's" place. The brakes were not holding like they should, the radiator leaked a bit and he needed new oil in his crank case.

The next day the tourist got his car. The piston slap was gone, the radiator didn't leak any more, and the brakes—well he never saw brakes take hold like they did. He supposed his crank case had been filled. He later found it had been. But how?

Oatmeal Stops Leaks

The radiator leak had been stopped with a mixture of bran and oatmeal which had been dumped into the radiator. An old trick of the "gyps." Some Fuller's Earth had been rubbed on the old brake bands and that was what gave them their awful bite. The slap had been taken out of the pistons by knocking them out of round with a hammer. And the "gyp" had filled the crank case with oil that had been taken out of other cars and allowed to settle so that it wasn't too dirty.

The easiest way is the thing that interests the "gyp" always. He has a makeshift for almost every part of the car. Four wheel brakes? Certainly. When they get out of adjustment and don't take hold evenly all the "gyp" does to fix them in to put a kink in one of the brake rods. Another "gyp" was called on to take care of a car with a rear main bearing leak. He simply removed the oil line that led to the bearing, soldered up the open end and let it go at that. What did it matter to him whether the rear main bearing got any lubrication or not?

The real "dirty work" of the "gyp" is done on the insides of the car, about which the public knows little. The transmission is a gold mine for the crooked garage man. He has a bottomless bag of tricks. Frequently he puts a pound of powdered sulphur in the transmission before the grease is added. After this is well worked up and stuck onto the gears, the grease is added and an almost perfect running transmission is obtained—for a while.

Shackle bolts are necessary in a car, but the public knows little about them. When they become worn and need replacing, the "gyp" drives little wooden wedges around points showing wear. All squeaks stop.

Bushings are also needed in a car, and when they are worn they should be replaced with new ones. But the "gyp" drives the old bushings out and cuts down one side with a hack saw. Then he takes a piece of shim stock, which is thin sheet brass, and winds a piece around the outside of the bushing. The old bushing is then replaced in the car, reamed out to the proper inside diameter and the job has been done at small cost—and will give small service.

"You need new pistons." Supposedly taken from the dis-assembled motor, the "gyp" shows the car owner broken parts kept on hand for duping the customer.

Sham Overhauling Fools Motorists

A lot of trouble is caused by the "gyps" for legitimate garage men. For instance, a "gyp" will sell a car as a 1923 model. Later something goes wrong and the owner tells the garage man that it is a 1923 model and gets a price for the job. When the car is brought in it is found that the part purchased for the car doesn't fit. Then the serial number is sought out and it is found that the car is a 1919 model. Frequently owners of cars buy new tire rims and get the wrong one through no fault of their own except that they do not know what model car they have. When such a thing happens the car owner is likely to blame the dealer from whom he purchased the tire rim, whereas the "gyp" who sold him the car is responsible.

Ignorance Is Costly

The car owner who has picked up a few technical phrases and a little mechanical knowledge is an easy target for the "gyp." Not long ago such a man dropped into a garage and told the boss that his motor was missing and that there was carbon in it.

"I must have my motor cleaned, the carbon is making it miss," he told the proprietor, who was glad to believe him.

"I'll fix it up for you in fine shape," the "gyp" assured him, and quoted him a price of $21 for the job.

This satisfied the owner and he went away feeling that his car would soon be back in first class condition. Later the car owner returned, got his car and drove away, after paying the $21. Everything seemed shipshape. How long it would remain so is a question.

All the "gyp" had done was take the nuts off the cylinder head, grease up the bolts and replace them, and put in one new spark plug that had a cracked porcelain. He did rub the motor block off a bit and that made it look as if it had been thoroughly gone over.

This mechanical tyro car owner, however, is about on a par with another of the species who has just a little technical knowledge. This other man, Smith we'll call him, went into a "gyp's" place one day and strutted his motor knowledge.

"I have a car out front that needs attention," he majestically said. "I have driven it about 7,000 miles and it needs oversized valves and new rings, besides a little overhauling."

"I'll fix you up, Mr. Smith," said the "gyp" without even so much as the bat of an eyelash; he was a keen student of human nature and knew enough to take Smith at his word.

The car was accordingly brought in and looked over and Smith was quoted a price of $185 for the job. The truth of the whole matter was that it was practically a new car then and in fine mechanical shape. Smith, however, had read of oversize pistons and a few other things and liked to display his superficial knowledge.

Here's what the garage man did for the $185. He took off the head and cleaned out the carbon. Then he took the pistons that were already in the motor and stencilled on the top of each .015, meaning 15/1000 oversize. The old pistons were then put back, the head replaced and the car delivered. The "gyp" got $185 and Smith was well pleased.

It may seem that a car owner is out of luck unless he has a dark skinned chauffeur who knows enough about cars to see to it that the garage man does his job in the way it should be done. But here, again, the car owner is sometimes cheated.

"Boss, yo' all better give me ten gallons o' gas and another spark plug," says Sam, a colored chauffeur in a large Eastern city, to a "gyp" garage and filling station owner.

"I got ya, Sam," pipes back the "gyp."

And Sam was given ten gallons of gas and nothing else. However, he signed for fifteen gallons and a spark plug, installed. His boss paid it and didn't know the difference.

Yes, the "gyps" seem to have it. And if they haven't gotten you yet, you had better watch out because, like the goblins and the ghosts and the witches, they will get you if you don't watch out.

A Garage With a Million Tacks

THE intricate pattern of the door decorations of the double garage shown in the illustration is traced entirely in nickel-headed tacks. The design was first sketched on the doors with a pencil and the tacks were hammered in place. The large number of tacks used has caused it to be called "the garage of a million tacks."

The walls are of bright blue stucco and the wooden doors are painted in the same color, so that the bright heads of the tacks stand out with silvery brightness against the background. The garage is attached to a private residence in Beverly Hills, California, and faces directly on the street so that passers-by may catch a glimpse of this unique structure.

The decorations on the doors are traced with silver-headed tacks.

NEW DISEASES CAUSED BY HIGH ALTITUDE FLYING

When the airplane becomes as widely used as the automobile, air travelers will be subjected to an entirely new set of disease conditions. This is the word of physicians who have been studying the effect of high altitudes and rarefied air on the human system.

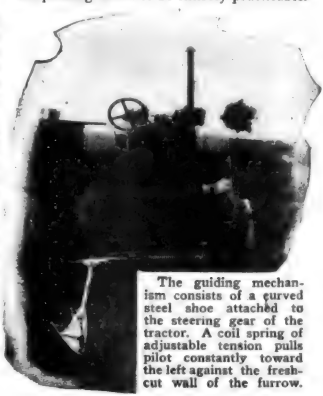
Flyers accustomed to traveling in the upper reaches of the earth's atmosphere will eventually develop an increased capacity to absorb oxygen in the lungs. The number of red blood cells will also very likely increase.

These anatomical changes will of course be a gradual evolutionary development, and it will take generations for humanity to become thoroughly acclimated to the varying conditions encountered at sea level and at 10,000 feet in the air.

Many war fliers who became accustomed to high altitude flying suffered injurious after effects. Acute alcoholism produces an effect similar to that which overtakes the rare-air flyer.

AUTOMATIC PLOW DOES AWAY WITH HIRED MAN

By equipping his tractor with an automatic pilot, the up-to-date farmer will be able to set his machine to work in the morning and return at nightfall to find his field entirely plowed and his tractor waiting for him with the engine shut off. Tests recently made at Pawnee City, Oklahoma, proved the piloting device to be entirely practicable.



The guiding mechanism consists of a curved steel shoe attached to the steering gear of the tractor. A coil spring of adjustable tension pulls pilot constantly toward the left against the fresh-cut wall of the furrow.

HOW TO BUILD

By T. W. HODGDON

An airplane that will fly well need not cost much. Here is an outline of the rudiments of airplane construction which will put the amateur flying enthusiast on the road to owning his own airplane. This article tells how a light airplane is designed.

This little ship, weighing only 400 lbs., flies with a 20 horsepower motorcycle engine—and it doesn't use all the horsepower at that! For description of such a plane read accompanying article, the first ever written in non-technical language for the novice.

"HOW can I get into aviation?" That question is on the lips and in the minds of the eveready, progressive young Americans of today. Thousands upon thousands of young Americans realize that within twenty-five years the airplane industry will outrival even the stupendous proportions of the automobile industry of today. These young men know in their very souls that aviation is the game for them. But the greater portion of this newly airminded population is bound to be disappointed. There are only so many positions open in the aircraft manufactories—and these are not only filled—but each position has hundreds of applicants ready to step into a vacant place.

One of the oldest and best known airplane concerns in the country recently found itself beset with a total of 25,000 applications from ambitious young men willing to work for little or nothing in order to get a start in the aviation industry.

There's a much easier and less competitive way for the young American to learn aviation from the ground up, and this is—build your own airplane.

The Easier Way to Do It

The question naturally arises in the reader's mind—"Is it hard to build a plane—is it hard to design a plane—and if I do design it and build it, will it really fly?"

There is but one answer. You *can* design a plane, you *can* build it yourself at small cost—and there is one way in which you may be absolutely sure it will fly. All it takes to be sure your plane will get into the air is a little plain arithmetic and the formulae given here.

To fly, and fly successfully, a plane must meet the following requirements:

1. The lift exerted by the wings must be greater than the weight of the plane loaded for flight.

2. The power delivered from the motor must be enough so that the thrust by the propeller will overcome the *resistance*

Beginning—A COMPLETE

an AIRPLANE and FLY IT YOURSELF

which the machine presents to the air. Resistance is measured in pounds, and so is thrust.

3. The plane as a whole must be *balanced* about a common center, known as the center of gravity—with control surfaces which, when moved, will revolve the ship about this common center. This means that the ship will be controllable in flight.

A light plane such as described above may be easily designed to fly with a motorcycle engine. By this, we do not mean to infer that an engine might be taken directly from a motorcycle frame and fitted into the engine-bed of a light plane ready for service. The Indian motorcycle engine of 72 cu. in. piston displacement will develop approximately 18 horsepower at 4,500 r. p. m. in a motorcycle frame. Taken from the motorcycle, and tuned especially for airplane service, this same motor may be made to develop in the vicinity of 25 horsepower with a degree of reliability which is astonishing. Just how the horsepower of the motorcycle engine may be increased will be described in full in next month's article.

Up aloft, free to go where you will! This little ship is being flown with a twin cylinder motorcycle engine and can make 65 miles an hour.

Design of Light Sport Monoplane

Let us take the case of a light sport monoplane which will fly with less than 20 horsepower, carrying one person with ease. In designing this plane, we will strive for stability and low landing speed, rather than high speed. Low landing speed is more desirable from a safety standpoint.

The very first essential for us to know before we can use any airplane design formula is the *weight* of the plane loaded for flight. The weight of the body of this machine will be about 150 pounds, including gas tank, seating and control arrangements, as well as the landing gear. The monoplane wing, including struts and wiring, will weigh about 65 pounds. The rudder and tail works will weigh about 20 pounds, which gives us a total of 235 pounds. Let us add 20 pounds for fabric covering, fittings, etc. The motor, complete with propeller, will weigh about 125 pounds, which gives us a total *empty* weight of 380 pounds. These weights can be checked up by the reader as we go further into the construction of the plane, as wood weighs a certain number of pounds per cubic foot, according to the species. Spruce weighs 25 pounds per cubic foot, pine weighs 25, fir weighs 28, and ash weighs 39 pounds per cubic foot.

It is astonishingly simple to calculate the weights of the wing panel, fuselage, and other parts, merely by finding the volume of each strut, longeron and wing rib, just as a schoolboy finds the volume of the water contained in a vessel of certain dimensions.

Now then—the weight of the plane empty is 380 pounds, and we must add the weight

of the pilot, 160 pounds, the weight of the gas and oil, 16 pounds. This gives a total weight, *loaded for flight* of just 556 pounds.

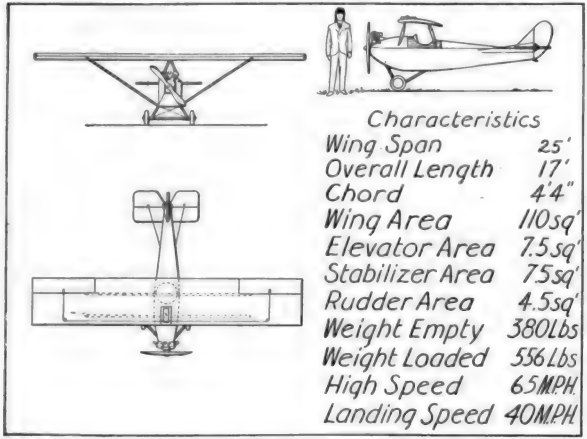
How Is the Lift Obtained?

In building or designing a plane of any sort we must first select a definite wing curve to use. We will select the U. S. A. 27 wing curve, using the data which is listed in Figure 2 of the drawings. This is scientific data, and without it we would not be able to calculate the possibilities of the plane's actual flying. The lift coefficient for the U. S. A. 27 wing curve at 8 degrees angle of incidence is .002521, as will be seen from the list in Fig. 2 of the drawings. Lift coefficient is a name given to a number which, when it is multiplied by the other factors entering into the design will give the desired answer.

We select the 8 degree position because we want to get the most lift possible in leaving the ground at slow speed. What we want to know first is—the number of square feet wing area needed to take the plane off the ground at 45 miles per hour, so we use the formula:

$$\text{WING AREA} = \frac{\text{WEIGHT OF PLANE}}{\text{COEFFICIENT} \times \text{SPEED} \times \text{SPEED}}$$

It is really quite simple to substitute weights in this formula. We know the coefficient of the wing, and we know the weight of the plane, and the speed is 45 M. P. H., so, substituting and dividing, we get 556 pounds, divided by the coefficient .002521x45x45, and the answer comes out as 109.01 square feet of wing area needed to fly the ship at 45 miles per hour. Let us figure high, and call it 110 square feet of wing needed.



Next, let us determine the size of our plane. Good dimensions are as follows:

Wing span	25 feet
Cord of wing (width)	4 feet 4 in.
Overall length	15 feet

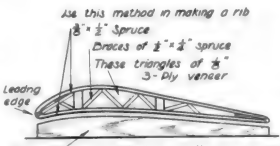
Now that we have the sizes determined, let us look at the assembly drawings in Figure 1. As you will see—this is a parasol type monoplane, with the wing above

the body. This design is noted for its strength with light weight, economy of construction, and most of all for its stability in flight. Let us now figure the power needed to fly this monoplane. Note that we are basing all calculations on a take-off speed of 45 miles per hour with the wing set at an angle of 8 degrees to the air. Actually, the wing is at 3 degrees with the fuselage.

The formula for power required is:

$$\text{Horsepower Needed} = \frac{\text{Resistance} \times \text{Speed}}{375}$$

Now before we can use this formula we must determine the resistance which the plane presents to the air at 45 miles per hour. This is done by using the following formula with the data we have in the lists in Figure 2.



Hints on building wing

K is a shape co-efficient determined from wind tunnel tests, listed in Figure 2 of the drawings. Area as referred to above is the cross section area as shown in the frontal drawings in Figure 2.

First let us use the above formula in determining the wing resistance. Consulting the list of coefficients, we find that the K for the U. S. A. 27 wing curve at 8 degrees is .0001534, and we know that we have 110 square feet of wing area. Hence, substituting in the formula we get: .0001534 x45x45 which equals 34.16 pounds. We must find the resistance of the various other pieces of the structure and add them all up to get the total resistance.

$$\text{RESISTANCE} = K \text{ (Coefficient)} \times \text{SPEED} \times \text{SPEED} \times \text{AREA}$$

To Figure the Fuselage Resistance

Now let us determine the resistance of the fuselage, landing gear, struts and tail surfaces. Looking at the list again we find that the K for fuselage shapes is .00120 and by looking at the frontal area drawings, we see that the area is about 6 square feet. Hence, the resistance figures up at .00120x 6x45x45 or 14.5 pounds.

It is easily possible to find the resistance of all the other items exactly as we found this one, so we will not go into further calculations here. For more information on the methods to use in determining the resistance of the various parts of an airplane, see the textbook of military airplanes, "Military Airplanes" by Grover C. Loening. This textbook is a masterpiece on elementary aircraft design, and constitutes much food for thoughtful study on the part of any aviation enthusiast who really desires to acquire some first hand information which is not too deep.

The resistance of the machine shown in the drawings will be as follows:

Wing resistance	35 lbs.
Fuselage resistance	14.5 lbs.
Wheels and landing gear	2.18 lbs.
Tail surfaces and struts	10 lbs.
TOTAL RESISTANCE	61.68 lbs.

It is advisable now to add at least 10% to these figures, because it will be remembered that the ship is inclined at an angle of 8 degrees for the take off, hence the resistance will be somewhat greater. Adding 10% to 61.68 lbs., we get 67.84 lbs. as the total resistance.

We may now proceed to find out how many horsepower are actually required to fly the plane at 45 miles per hour. The formula with values in it will look as follows:

$$\text{HORSEPOWER} = \frac{\text{RESISTANCE } (67.7) \times \text{SPEED } (45)}{375}$$

Multiplying and dividing this out we get: 8.11 horsepower actually required. Considerably less than nine horsepower will fly this plane then, at 45 miles per hour.

Constructing the Plane

Now that we have taken up the elementary principles of airplane design, it should be possible for anyone, with a little study, to get designs together, and make drawings or have them made from their own preliminary sketches. Of course, the designs which we have followed through in the first part of this article are such that the plane

How a Plane Obtains Flying Lift

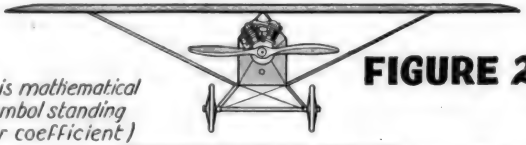
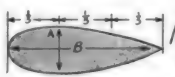


FIGURE 2

(K is mathematical symbol standing for coefficient)

In figuring resistance use the K listed here for the various bodies



Strut
Max. Diam.
⅓ back

K = 00038 A = ¼ B

Wire cable
K = 00290

Fuselage K = 00120

Wheels
K = .002

Resistance = K × Area × Speed × Speed
For Area see drawing at top of this page

List of K's for U.S.A. 27 wing curve at various angles of resistance.

Lift = K × Area × Speed × Speed

↑ Lift K's for U.S.A. 27

At 3° angle of incidence	= .001611
" 4° " " "	= .001734
" 5° " " "	= .001918
" 6° " " "	= .002148
" 7° " " "	= .002312
" 8° " " "	= .002521

Resistance of K's For U.S.A. 27

At 6° angle of incidence	= .0001023
" 8 " " "	.0001534

To Find Power required use Formula

$$H.P. = \frac{\text{Resistance} \times \text{Speed}}{375}$$

Follow These Formulae in Designing Your Plane

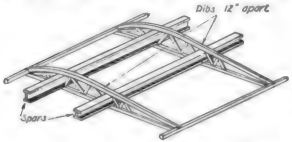
will fly, and it may be that the builder will prefer to utilize them as they are.

In constructing the plane, it is most essential to get the structure as light as possible, with the greatest of strength. After you have designs for your plane complete, and have had drawings made, the complete drawings should be submitted to a reliable engineer for stress analysis, in order that you may be sure the structure will be strong enough.

An engineer can make stress calculations and tell you if the sizes of the various members are strong enough to stand the strains imposed on them. Each type of airplane demands different strength in different parts, hence it is very important that you proceed to get your plane drawings inspected.

How to Construct a Fuselage

In the drawings in Figure 3 we show a good type of modern inexpensive, easily



built fuselage construction. This type, known as the stick and wire type of building, is familiar to almost all light plane builders, and while it is being rapidly supplanted by steel tubing, the welding of the steel tubing and its uncertain strength when built by amateurs has led us to defer the building of such a fuselage until a later date. The fuselage shown in the drawings has plywood formers, ash longerons, and the small turnbuckles are made from motorcycle spokes and 19 gauge sheet steel, cold-rolled.

In the fuselage shown, which will do for any light plane of the type under consideration for motorcycle power, the longerons should be $\frac{7}{8}$ by $\frac{7}{8}$ inches at the bow of the ship tapering to $\frac{5}{8}$ by $\frac{3}{4}$ inches at the stern post. The struts and engine bearers should be of spruce. No particular paring of dimensions should be done on such a fuselage, as there are so few structural members that the weight saved would be inconsequential. The plywood formers are of the brand of plywood known as Haskelite, and may be secured from the Johnson Airplane Supply Company, who do a large airplane parts business at Dayton, Ohio. The wire for the turnbuckles and the nickel steel bolts may also be secured from the same source.

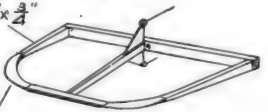
Make aileron and control panel hinges from $\frac{3}{8}$" rod as shown here.

Another type of fuselage construction consists of framing with a Warren truss of light spruce members. These are secured to the longerons with a set of plywood gusset plates. Such a method of building up a fuselage is very cheap, but is not so rugged as the somewhat heavier type shown in Figure 3. The fuselage in Figure 3 should not cost over $10 to build.

A light, strong landing gear assembly is shown in the drawings. Upright members of steel tubing, with a plate welded or bolted across the bottoms to hold the rigid axle, with diagonal wire bracing as well as bracing to front and rear. Use wheels which can be purchased from any Aero supply

Construct elevators, rudder, etc. as shown here.

$\frac{3}{8}$" x $\frac{3}{4}$"



Corner pieces of $\frac{3}{8}$" flat spruce

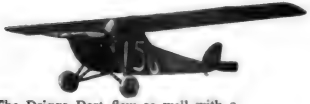
house, but do not use wheels with less than 3-inch tires, as these wheels will catch in ruts and will prevent easy handling on the ground.

Some Amateur Airplane Jobs

This neat little ship is a Meteorplane model of biplane type. Powered with a two-cycle four-cylinder motor she can tear along at 90 miles an hour. Her span is only 20 feet, and length 13 feet.

This two-cycle Meteormotor weighs but 60 pounds.

A two-seater with a V type engine has high performance.



The Driggs Dart flew so well with a converted Henderson motorcycle engine it won many light-plane contests.

Pilot G. Shank, well known Northwest air pilot, with his home made plane.

The Myers Midget can do 100 miles an hour with ease. It is a single seater with a two-cylinder engine. The span is only 16 feet.

Here's the homebuilt biplane Gene Shank built when but 16 years of age. Powered with an 11-horsepower Harley Davidson it flew very well.

These Types of Plane Are Reliable Performers

Have an Engineer Analyze Your Drawings

Tail Surface, Size, Construction

In constructing the tail surfaces, construct them to dimensions which may be a trifle oversize, rather than undersize. Construct framework as shown in the drawings, with dimensions given. These tail surfaces should be ample for a plane of the size shown in Figure 1.

Hinges for rudder, elevators, and ailerons may be simply and easily constructed from pieces of cold rolled rod, as shown. Horns or levers to attach control wires to are made integral with the different surfaces as shown in the sketches.

Construction of the Wing Panels

The wing panel must be constructed with the curve of each rib exactly the same, and to facilitate matters, a template must be made, as shown in the drawings. To make one of these templates, it is necessary to secure a full size blueprint of the wing curve we selected to use—the U. S. A. 27. Any airplane supply house will supply a blueprint of this curve, or it may be obtained from the National Advisory Committee for Aeronautics, Washington, D. C. If the wing curve is not followed in each and every rib, the wing will not lift as it should, and you are likely to have a plane which will not fly at all. It is very necessary to have a wing which is correct.

Build the two wing spars up to fit the two spaces in the wing curve, as shown in the drawings. You will have to determine the actual cross section of the spars from the blueprint of the wing curve you use. It is possible to build a light, strong, spar up out of three pieces of spruce, making them up into an I section, glueing and nailing them together. The front spar should be heavier and stronger than the rear one, as it has to take about 60% of the load on the wing. The spars form the back-bone of the wing structure, as shown in the top view of the wing panel in Figure 4 of the drawings. The ribs, built and braced as shown, may be all built at once and then slipped on over the spars and nailed in place.

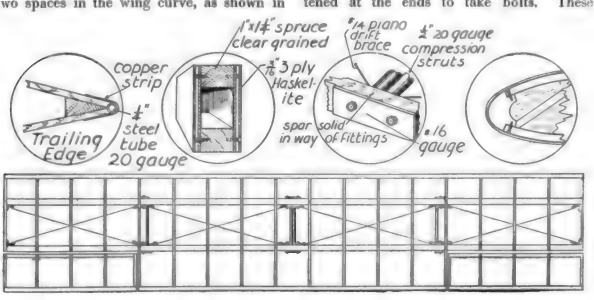
When nails are mentioned we refer to small brads about ¾" long—never use nails any larger.

Build ailerons as shown in wing panel drawing.

After the ribs are in place on the spars, put the leading edge and the trailing edge in place and nail them to the ribs as shown. The entire wing panel should now be well braced diagonally with wire and turnbuckles. See top view of wing panel. Use a good grade of piano wire for this diagonal bracing.

Steel Tube Wing Struts

The center cabane struts which hold the wing panel at its center above the fuselage, should be made of ¾" steel tubing, flattened at the ends to take bolts. These



Details of Fuselage Construction

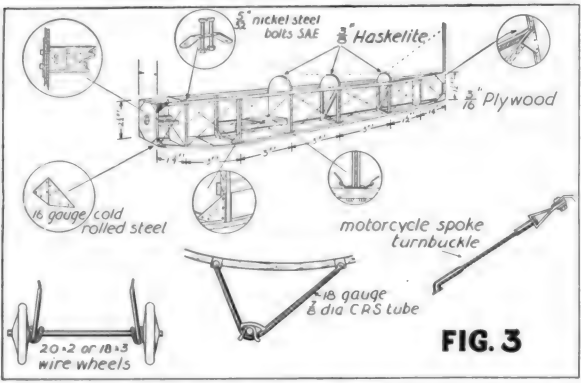


FIG. 3

struts attach to the four heavy fuselage uprights. See fuselage drawing. Likewise, the outrigger struts which brace the wing panel at a point several feet from their tips should be of ¾" steel tubing. These steel tubing struts should be streamlined by fairing as shown, and wrapped with cotton or linen airplane tape.

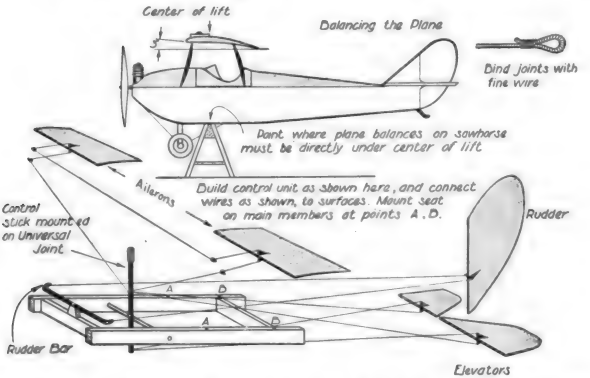
The wing panel should now be covered with cotton or unbleached muslin. Tack it along the leading edge, using copper tacks, and draw it back toward the trailing edge as tightly as possible, then tack it in place and cover the bottom of the wing panel likewise. See that it is tacked to each rib, both top and bottom, at least a foot apart. Follow same procedure in covering rudder, elevators, fuselage, etc.

Now obtain some airplane *dope* from any airplane supply house, and apply this liquid with a good paint brush about 2" wide. Spread the dope evenly and not too thickly onto the entire wings, elevators, rudder, fuselage, etc. After one coat of dope, it is time for the tape. Get some scalloped airplane tape about 1½" wide, and fasten it along the places where there are rows of tacks. Then dope it and it will stick down in place tightly, making a neat, streamline job of all joints. This applies to the leading and trailing edges of the wing, the tops and bottoms of the ribs, and the corners of the fuselage also. The cloth will be drum tight after doping, and a thin coat of paint or varnish can now be applied. The wheels also may be covered to advantage.

Control Mechanism and Seat

The seat, rudder bar and control stick should be built in one unit on a pair of chassis members of spruce about 2"x2", as shown in the drawings. The stick is made of steel tubing, arranged so that it will pivot in any direction. About 6" above the pivot, attach a clip for the control wires, as well as to the bottom end of the stick, which should be about 6" below the pivot. The rudder bar may be made of steel tubing or of spruce, according to the builder's ingenuity. In all this work, bear in mind that extreme lightness with greatest of strength is necessary. Connect controls as shown in the diagram—*But do not connect the controls until you have balanced the airplane as a whole as described in the next section.*

Making Sure *of* Correct Balance



In balancing an airplane, the center of gravity—the point about which the machine will balance—must be directly under the center of lift. Looking at the diagram showing center of lift you see the airplane mounted upon a sawhorse. It may be actually balanced by this simple method.

This balancing operation must be conducted after the engine has been fitted in place, complete with propeller. Get the tank filled with gasoline, the oil tank filled, and get into place in the pilot's seat yourself—with the machine on a sawhorse, as shown. Now have a helper move the plane forward and backward until the plane balances on the sawhorse. The point at which it balances must be *directly underneath the point on the wing which is the center of lift.* The center lift for the U. S. A. wing will come at a line drawn from wing tip to tip about 35% to 40% back from the leading edge. In the case of the U. S. A. 27 wing curve, with a chord of 4 feet 4 inches, such as we figured on here, the center of lift will be about 20 inches back from the front of the wing.

If you find the wing is not in the correct place, balance the plane by moving the whole pilot's seat and control assembly backward or forward—or alter the position of the wing itself by shortening or lengthening the center struts which hold the panel above the fuselage.

This wing panel should be set at exactly 3 degrees angle of incidence, when the plane is absolutely horizontal in flying position, as it is shown in the side view. Use a protractor and a straight edge for lining this work up.

In the next issue, we will describe in detail, with the aid of drawings, just how to tune up a motorcycle engine so that it will fly a light airplane nicely. Also, we give directions for flight-testing the completed job.

Electricity *from* Air

Below is shown a Viennese inventor with his machine for generating electricity from the air.

At the right is the current-producing air wheel as it looks from the outside.

These piano players aren't posing for a rattling good illustration for one of Edgar Allen Poe's grim stories. The skeletons are employed by a music school to illustrate the round-shouldering effect of sitting on a piano stool without a back rest.

NEW *in*

—Times, Wide World.

Imagine the embarrassment of the crew of this motorboat when the heavy sandbag dropped by the airplane lands on their deck! This is a new sport, with the swooping airman trying to score a hit

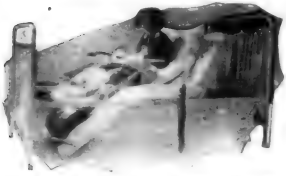
How would you like to bite this six-foot cylinder out of a block of solid granite? A new rotary core drill cut this tube out of the granite slab in a few hours.

The motor of this tiny yacht is installed beneath the aft deck and exhausts through the open end of the boat. It can be attached or removed at will.

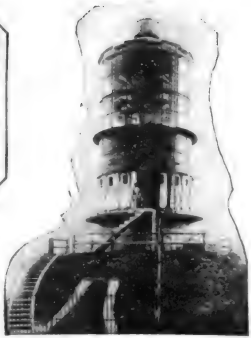
Science keeps pace with the needs of man, as shown by these latest developments from the far corners of the globe.

KINKS Science

Human minds must be agile indeed to keep abreast of the bewildering progress of science throughout the world.



This hospital bed can be changed to an invalid's chair in the twinkling of an eye, to permit the patient to sit up for a cup of tea.

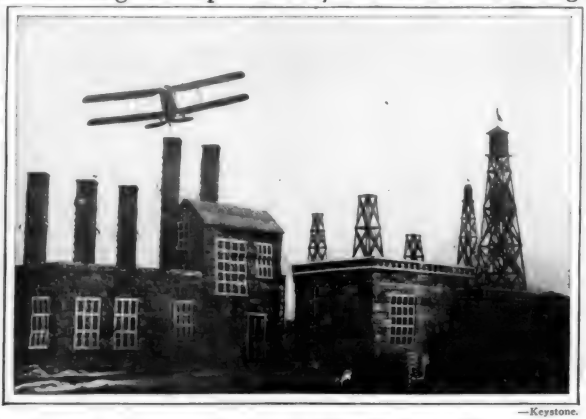


This 60-foot lighthouse keeps sailors from going on the shoals off the Danish coast. Note the unusual arrangement of reflectors inside the glass-enclosed tower. The height of the lighthouse is graphically shown in comparison with the figure of the attendant near the door.

The familiar Pathe rooster is shown here strutting his stuff in front of the sound recording device of the newest talking movie machine. He is the first talking trademark to appear on the silver screen.

The teeth of this new portable saw will cut through a log in one tenth the time required by the ordinary cross-cut. It is powered by a compressed air motor.

Bombing a Paper City With Sand Bags



—Keystone.

A "HOUSE of cards" representing derricks and office buildings of oil fields in the near East was constructed as a target for airplanes in a recent British aerial pageant. The picture shows a fighting plane ready to drop a sandbag on the flimsy buildings. A direct hit will cause the paper structure to collapse as if struck with a high-powered bomb. Note the ropes bracing up the chimneys and derricks.

—Keystone

MAGNIFIES VIBRATIONS 1,000 TIMES

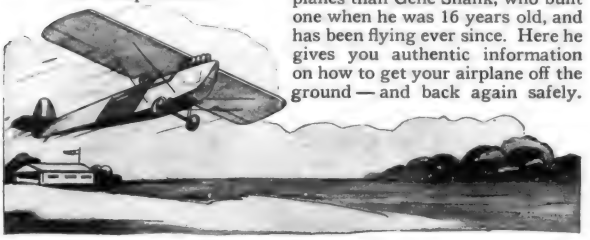
A seismograph so delicate that the heat from a lighted cigarette will affect its accuracy has been installed in a specially built cellar at Fordham University, New York. The cellar is built with 18-inch concrete walls to absorb surface vibrations and to insure constant temperature. The floor is separated from the walls, going down to bedrock, on which the instruments are mounted. Some idea of the delicacy of the new seismograph may be gained from the fact that it registers a steady vibration during a snowstorm.

Sitting in his special cellar, Father John Tynan can get an accurate record of an earthquake occurring 7,000 miles away. Earth vibrations are magnified 1,000 times. The new instrument is known as a Willip-Gallitzan seismograph, and is imported from Esthonia.

Contact! Here's the *First Lesson in* FLYING

By PILOT GENE SHANK

Who broke the world's Loop-the-Loop Record



Few people know more about airplanes than Gene Shank, who built one when he was 16 years old, and has been flying ever since. Here he gives you authentic information on how to get your airplane off the ground — and back again safely.

EVERY good flier must acquire certain knowledge of the principles of aviation before he takes to his wings. He must have a full and complete knowledge of the reason an airplane is able to fly, and he must know how an airplane is built. A pilot is never better than his knowledge of his ship.

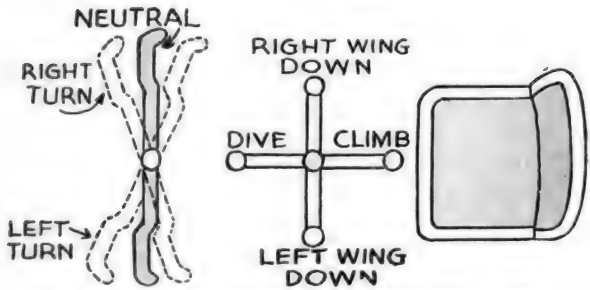
One of the best ways in the world to acquire this knowledge is to build an airplane of your own. After having worked out your own problems in the building of your own plane you will have a much better conception of the workings of an airplane than could be had in any other way, with the possible exception of a thorough ground school course which is usually expensive. Both ways of preparing for an air career are good; each has peculiar merits to recommend it. Bear in mind that mortality among students varies inversely with the amount of preliminary training. The greater the knowledge, the more apt the pilot is to come through his solo flight safely.

While it is not recommended that you read this and attempt to take a ship into the air, you pilots of tomorrow may profit by a little "chin session" and ground talk, so that you will have a pretty good idea of the things a "kaydet" goes through in getting his ship into the ozone.

In flying an airplane there are two things a student should know and drill into his head until the knowledge is a subconscious part of him. First, *always keep flying speed;* second, always keep in mind *what position you are in relative to the wind.*

Without those two things ever in mind, you cannot safely or properly handle your plane—flying speed especially being the greatest of these two factors. Flying speed is obtained and maintained from two sources. The thrust of the propeller is the first of these two sources, and gliding is the second. In case your primary source of speed ceases for any reason, known or unknown, the immediate thing to do is to nose the plane into a glide sufficient to maintain flying speed. Don't worry about what the trouble is before you nose her down into a glide, or your troubles will pile up and so will the ship.

With these two precautions dinned into the old noodle, you are ready to seriously entertain the notion of taking a ship aloft.



The pilot's seat in an airplane cockpit is shown in this diagram. Various movements of stick and rudder control direction of the plane as illustrated.

The next precaution to take is a humane measure designed to prolong your life, promote your health, and initiate you into the ancient order of Native Sons from Missouri.

It is this: Don't take anybody's word that there is enough gas aboard, or oil or water. Check these points yourself! See for yourself that the work delegated to mechanics is properly done. See that the plugs are tight; examine the principal control wires and move the rudder bar and control stick in all directions to make sure the ailerons and elevators and rudder are on the job and functioning properly.

The motor should be run idly until it is thoroughly warmed and the oil is circulating at the proper pressure. Test the old mill out for revs, reading from the tachometer without which no plane is complete, and be sure not to race the engine for more than a few seconds when determining this.

During this preliminary warming up the wheels should be well chocked, or the wings held by men to prevent the machine from getting under way when the motor is gunned.

When the power plant is functioning reliably, taxi to a smooth level runway with hard dry ground having short grass. If possible avoid rough ground, soft ground, or ground having hummocks of grass. Make sure before finally heading into the wind that all controls are working properly, that no planes are coming in to land or take off, then deliberately "give her the gun" as fast as the motor will speed up. Avoid throwing the throttle wide open all of a sudden. High compression motors last longer if full loads are shouldered gradually. Start off with full power directly into the wind.

When the ship has attained fair speed, which is usually within 25 to 50 feet, push the stick gently forward. This raises the tail and at the same time prevents the ship from leaving the ground until it reaches proper flying speed.

At this point it is well to impress you with the need for pulling back gently on the stick after the ship levels off on her run along the ground. Otherwise the tendency will be for the ship to raise her tail, with the attendant danger of lowering the "prop" until it hits the ground.

When the machine has attained full speed on the ground, pull the stick back slowly until the wings assume the lift and take the machine off, taking care that the ailerons are in neutral position until the machine is well up in the air.

Taking off at high speed is always best as the machine will have attained a certain amount of momentum which will enable it to land safely if the power should fail suddenly.

As soon as the plane is under way it should be driven in a straight line at a very gradual angle of climb until a safe altitude has been reached at around a thousand feet.

Bear in mind that the possibility of the power plant conking out is ever present, and the flyer's first concern is to get altitude which can be converted into flying speed should such an accident occur.

The plane should be at a height of at least a thousand feet before any kind of turn is attempted. This advice holds true for all save the most experienced pilots. If a turn should accidentally become necessary, nose the machine down level in order to maintain flying speed with which to negotiate the turn.

The modern airplane of good design has considerable inherent stability, and it is always better to work the controls smoothly and easily than to jerk them. The novice's one great fault is apt to be the "hardness" on controls. Owing to the spread of a ship's wings, immediate response is not always had at the controls. The slower and larger the airplane is, the more time is needed for controlling it. This is one of the reasons why flying is an art—so much depends upon the judgment of the man at the stick. It is one of the reasons why flying cannot be learned in a five-minute hop, like a five-minute auto demonstration in which the owner learns to drive his car.

Certain precautions must be observed when landing. When you have approached sufficiently close to your landing place to be sure of reaching it on a normal glide, throttle the motor, keeping prepared to give her the gun if there is any doubt about reaching the field. Do not attempt to stretch a glide. Do not land in a cross wind if it can be helped. Always land into the wind. This exerts a braking effect on the ship and will make it easy to control.

One of the most serious mistakes the novice is apt to make is gliding into the field at too flat an angle, with the attendant dangerous result that the ship is apt to lose flying speed, and settle instead of gliding as it should. Either a stall and a total washout will occur, or the ship will pancake and damage the landing gear.

All students of aviation should bear in mind that it is not possible to learn to fly by reading a book any more than it is possible to learn to ride a bicycle or learn fancy diving by reading books on those subjects. There is needed a certain co-operation of the senses to produce the required sense of balance. Nothing but guided practice under the eye of a skilled pilot will enable the aviator to fly properly.

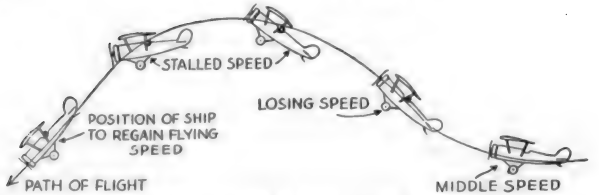
The novice may argue that the Wrights or that Glenn Curtiss taught themselves to fly without remembering that nothing but straightaway flights were made, and then only on days when the smoke from a cigarette went straight up into the air. It is much better to acquire at first hand the knowledge which has been gleaned by experience.

The control of a machine in the air is not difficult, as the pilot soon learns the necessary movements and acquires the reflexes which enable him to fly instinctively. The landings are the most difficult thing as good ones are made only by a combination of judgment of distance and an instinctive feeling for air conditions and direction.

So this is my little "ground talk," gang. Same as I give the Kaydets who go riding with me the first time in preparation for

PILOT GENE SHANK broke the world's loop-the-loop record last year in St. Paul, Minnesota, with a total of 569 aerial somersaults. He also holds the endurance record for light airplanes, having refueled his Waco biplane in the air to keep it aloft 12 hours. He says, the best way to learn to fly is to build your own plane.

Modern Mechanics gives you the opportunity to learn in this fashion. After an extensive investigation of some ten of the best light planes, we arranged with the most successful of these to publish their designs. No other magazine has ever attempted publication of a series of this nature, taking up both building and flying in all its phases, with complete, working plans, devised by experts.



When your engine stops while in the air, a simple manipulation of the controls will enable you to nose down and regain flying speed.

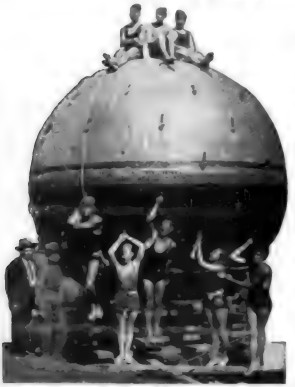
their solo flight. I haven't presumed to teach you to fly by letting you read what I have written here for you. But if you must, go to it!

And if you should ever show up at my flying field at Robbinsdale, and want flight instruction, I'll tell you the same thing. Then we'll put a helmet and goggles on you, trundle the new Waco out onto the tarmac, and up we go!

Contact!!

Fine points of airplane piloting will be taken up by Mr. Shank in the next article in this series, which will appear in the December issue of Modern Mechanics magazine. If you want to acquire a sound understanding of the theory and practice of flight, there is no better way than to follow the articles by experts in this magazine.

14-Foot Ball Gives Swimmers Thrill



Monster floating ball used by bathers at Catalina Island, California. It is fourteen feet in diameter.

A FOURTEEN foot ball with over 100 handholes is providing much sport for bathers at southern California beaches.

The ball is made of sheet iron laid over a network framing of angle iron. It is, of course, hollow and very buoyant. The object is for one group of players to submerge the colors of their opponents. For this reason, the two halves of the ball are painted brilliantly in contrasting colors.

Before a game is played, the ball is partly submerged by filling it with water. This robs it of some of its tricky buoyancy, and by crawling hand over hand on the ball the more daring players lend their weight to submerging the other side. This results in much skill being developed by the players in maneuvering the ball.

It is not an uncommon sight to see fifty bathers engaged in the serious fun of submerging the colors of the opposing side. Such games often last for hours at a time.

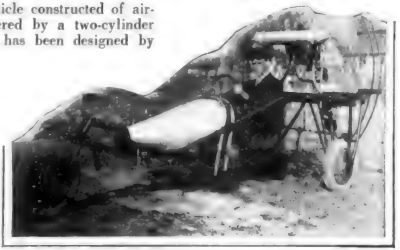
It is impossible for any of the participants to become hurt through contact with the ball, as the outside is covered with a rubber sheeting.

Inventor Makes Propeller-Driven Tricycle

A THREE-WHEELED vehicle constructed of airplane parts and powered by a two-cylinder motor and small propeller has been designed by John Dacy, a young inventor of Zion City, Ill.

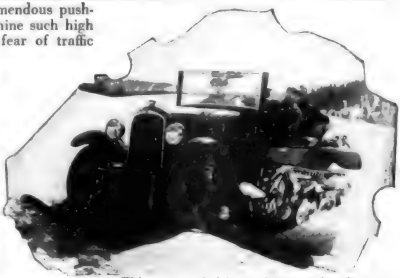
The rear part of the machine consists of an airplane landing gear on which is mounted the motor and propeller. In front of this is the pilot's seat, suspended from a frame of steel tubing. The lone front wheel is connected by chain and wire to the steering apparatus.

The propeller develops tremendous pushing power and gives the machine such high speed that its owner has no fear of traffic officers.



AUTO CONQUERS ALPINE PASSES

The St. Gotthard Pass, Waterloo to many an Alpine motorist, holds no terrors for the motor sled shown in the picture. The front wheels are equipped with thin skids that support the weight of the car in passing over soft snow banks. An auxiliary skid is fastened to the front spring assembly and passes under the radiator apron, providing additional support for the weight of the motor. Power is applied through caterpillar treads of the Citroen type. Nothing less than an avalanche is capable of stopping this Alpine car.



This motor sled is used by tourists in crossing the snow-covered passes of the Alps.

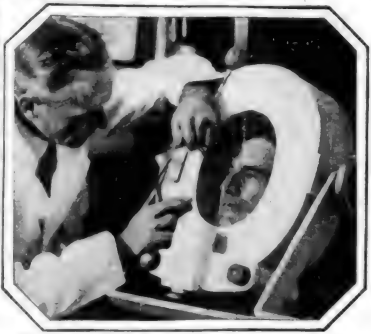
—Keystone.

BIBLE HIDES DRUGS

Mechanical ingenuity of narcotic smugglers is constantly being tested in devising new methods of bringing their contraband goods safely into the country. The picture shows a Bible which has been hollowed out in the center to provide a hiding place for thousands of dollars worth of morphine and other opiates. The book was confiscated by Internal Revenue inspectors.

REMOVES METAL PARTICLES FROM EYES WITH RING MAGNET DESIGNED IN ENGLAND

ONE of the latest developments in the field of medical science is the ring magnet. It is proving of great value in removing pieces of metal from the eye after an accident. Workers in various industries often suffer from flying pieces of metal striking the eye. To remove such small particles is often a delicate operation whose pain is greatly lessened through the use of this ingenious device. The operation shown here is being performed by Sir Richard Cruise, surgeon-oculist to the King of England and surgeon to the Royal Westminster Ophthalmic Hospital.



WALKING ON THE WATER NEW GERMAN SPORT

Waterproof "shoes" in which the wearer can walk about at will on lake or river surfaces are proving popular in many parts of Europe. The "shoes" are miniature boats of light construction, covered over and fitted with air chambers, and so designed that it is impossible for the water-walker to capsize them.

A funnel attached to a broom handle is carried, one stick in each hand, to give the walker the necessary "thrust" and to aid him in balancing.

These pontoon shoes are used in the popular European sport, walking on the water.

MAIL BOX FOR MOTORISTS

Mail boxes equipped with an extension lever and placed close to the curb so that motorists can drive up to the sidewalk and mail letters from their cars have been installed in Sacramento and Oakland, Cal. They are proving very convenient for motorists.

RUBBER AUTO BUMPER *Absorbs* SHOCKS

These cushion bumpers absorb jolts and jars through special "ice-tong" springs.

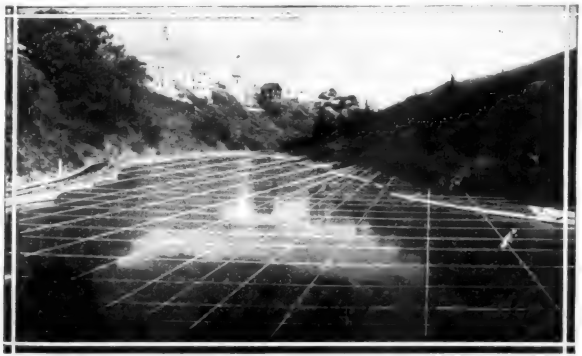
AN AUTOMOBILE bumper made of rubber and designed to absorb the shocks of minor automobile collisions has been put on the market. The device consists of a length of solid rubber tubing attached to two "icetong" levers supported by the front spring coverings.

The picture shows the cushioning effect of the bumpers in head-on contact. The device, of course, is not efficient at excessive rates of speed, but is highly effective in absorbing everyday jolts and jars.

Wire Network *Fools* Seagulls

RESERVOIRS containing the water supply of a California city were becoming favorite nesting-places of sea-gulls flying in from the nearby Pacific until engineers hit upon an ingenious method of sheltering the pools. Wire cables were stretched across the reservoirs, dividing them into checkerboards marked off into 50-foot squares. The wire network proved entirely successful in protecting the pools from sea-gulls, the birds steering clear of water criss-crossed by the shiny wire.

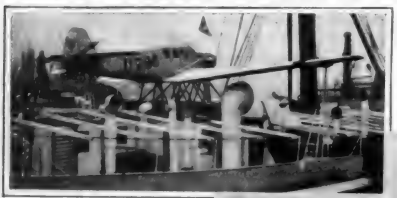
Until the simple network method was devised attempts were made to drive the gulls away by shooting. An automatic exploder was installed, but it was expensive to maintain and not so efficient as the wire cables.



—Engineering News Record.

City water reservoirs are protected from becoming swimming pools for sea-gulls by stretching wire across the surface.

Plane Carries Tourists on Side Trips



The pictures show the method of carrying a hydroplane on a steamship, ready for the use of passengers. The circle below shows the big hydroplane moored to the ship's deck.

AIR and ocean travel are combined in a Mediterranean steamer which carries a hydroplane on its deck for passengers' use. When the ship calls at points of historic interest the hydroplane is launched and tourists are given a view of the strange city from the air.

The hydroplane is powered with a 320 h. p. motor and can carry five passengers in addition to the pilot and mechanic. The flying boat is carried on the stern of the steamer where it can easily be lowered into the water when desired.

PNEUMATIC BOATS BECOMING POPULAR

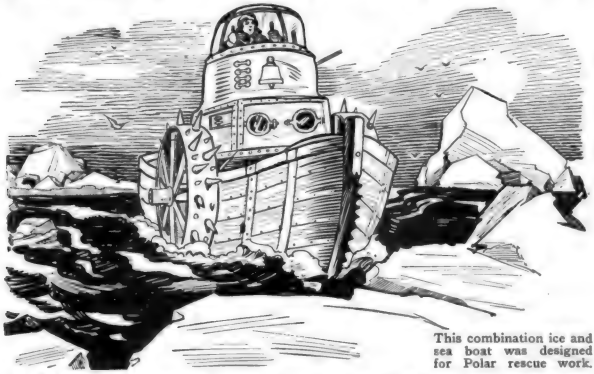
Pneumatic boats which can be folded into a small package and inflated for use when the need arises are winning popularity among sportsmen and aviators. Many flyers who must cross large bodies of water carry such boats as a safety measure. The picture shows one of the rafts being inflated with compressed air.

These rubber life rafts are shown being inflated from a tube of compressed air. Note leather oarlocks.

Leather oarlocks for two rowers are provided. Straps hold the oars in place. The boats are so designed that when fully inflated the bow and stern rise to a point, enabling the craft to ride through whitecaps and survive a heavy sea. Its portability and extreme bouyancy are selling features.

This is the type of boat which was brought into prominence by trans-Atlantic flyers. Byrd and others carried life-rafts similar to those shown. Such boats are of little value in the open sea during heavy weather, but are valuable for emergency service.

Rescue Boat Travels on Sea or Ice



This combination ice and sea boat was designed for Polar rescue work.

AN ARCTIC boat designed to run both on ice and water has been invented by Harold E. Bailey of Nashville, Tenn., for the purpose of rescuing polar parties marooned in the great ice fields. Difficulty in reaching the marooned members of the recent Nobile expedition was experienced because of the shifting ice floes with stretches of open water between them. A ship cannot cross the ice fields and dog sleds are helpless in navigating open water. It is its ability to travel in both mediums which makes Mr. Bailey's rescue ship so adaptable for use in the far North.

In design the boat is very simple. It consists of a stout wooden hull reinforced by metal strips, with spiked side wheels. The prow of the ship is fitted with a steel "saw tooth" blade which splits the pan ice. When the ice field becomes too solid for water navigation, the boat crawls up on the ice and slides along on its steel keel, propelled by the spikes, which have a bull-dog grip on the ice.

The navigator sits in a glass-enclosed cabin high above the deck, where he has a clear view of the country around. A crew of half a dozen men can be accommodated in the boat. Radio antenna can be strung on deck if desired. Foghorn, compass, and other instruments are carried.

The boat is useful not only in rescue work, according to the inventor, but can also be carried by the mother ship on polar expeditions, where it is useful in making short excursions where the larger boat cannot travel.

New Metal Rivals Aluminum

A NEW metal called beryllium, extracted as a by-product of waste ores from feldspar mines, is soon expected to rival aluminum as a material for manufacturing household utensils and motor parts. Beryllium is much harder than aluminum, yet weighs about one-third less. It is four times as elastic as aluminum, and it resists destructive fumes which corrode most other metals.

The commonest type of beryllium ore is known as beryl, sometimes worn as a semi-precious stone.

Skyrocketing to

Rocket machines operate more efficiently in the vacuum of interstellar space than in an atmosphere. Will science be able to harness this new force for interplanetary travel?

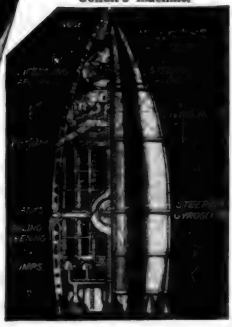
SCIENTISTS say that in the next few months we may see the first trials of man-carrying rockets, which will be shot off into space in an effort to land some intrepid adventurer on Venus or Mars!

Visions of a Jules Verne voyage to another planet are actually nearing realization through the lessons learned from recent rocket tests made by Fritz von Opel and Anton Raab, two Germans who have made exhaustive studies of rockets as a means of propulsion.

Through lessons learned from applying the rocket-propelling principle to the Opel rocket-propelled car, an American, Robert Condit, has constructed an interstellar rocket in which he intends to shoot himself to Venus.

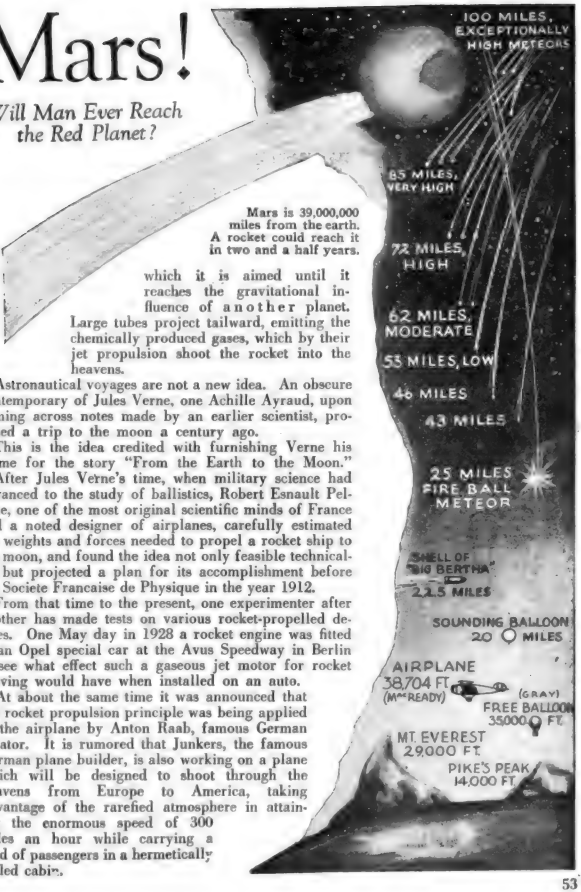
This rocket is capable of carrying a man beyond the influence of the earth's gravity, it is claimed, where its speed will carry it along the orbit on

Robert Condit, above, is shown adjusting the rockets of the machine which he hopes will carry him to Venus. Below is a diagram of the working parts of Condit's machine.



Mars!

Will Man Ever Reach the Red Planet?



Mars is 39,000,000 miles from the earth. A rocket could reach it in two and a half years.

which it is aimed until it reaches the gravitational influence of another planet. Large tubes project tailward, emitting the chemically produced gases, which by their jet propulsion shoot the rocket into the heavens.

Astronautical voyages are not a new idea. An obscure contemporary of Jules Verne, one Achille Ayraud, upon coming across notes made by an earlier scientist, proposed a trip to the moon a century ago.

This is the idea credited with furnishing Verne his theme for the story "From the Earth to the Moon."

After Jules Verne's time, when military science had advanced to the study of ballistics, Robert Esnault Pelterie, one of the most original scientific minds of France and a noted designer of airplanes, carefully estimated the weights and forces needed to propel a rocket ship to the moon, and found the idea not only feasible technically, but projected a plan for its accomplishment before the Societe Francaise de Physique in the year 1912.

From that time to the present, one experimenter after another has made tests on various rocket-propelled devices. One May day in 1928 a rocket engine was fitted to an Opel special car at the Avus Speedway in Berlin to see what effect such a gaseous jet motor for rocket driving would have when installed on an auto.

At about the same time it was announced that the rocket propulsion principle was being applied to the airplane by Anton Raab, famous German aviator. It is rumored that Junkers, the famous German plane builder, is also working on a plane which will be designed to shoot through the heavens from Europe to America, taking advantage of the rarefied atmosphere in attaining the enormous speed of 300 miles an hour while carrying a load of passengers in a hermetically sealed cabin.

In tossing a ten-pound shot or a javelin, the arms momentarily loose close to a full horsepower—that is, champions' arms do. Kaare Krogh and Vio Libby of the University of Chicago are shown at these events, in which they star.

—Ewing Galloway.

"Little Poker Face" Helen Wills whangs a ball across the net with her quarter-horsepower right arm. Here it's a skill that turns the trick!

Science

Scientists say your proficiency in sports depends on the "wallop" at your command. Measured in terms of horsepower, how strong would you have to be to equal these star performances?

—Ewing Galloway.

Lunging and parrying, fencers develop powerful shoulder and wrist muscles which are capable of doing the same amount of work as the motor which drives your washing machine, or about a quarter horsepower. This shows J. R. Hoffman and G. J. Wolf in action. They are Yale's fencing team.

—Ewing Galloway.

A man with a sledge, by taking advantage of the lever principle can develop enough power to kill a cow. Jack Dempsey, shown here on shipboard in action with Bob Kent, once killed a yearling with a wallop over the heart with his bare fist. Some sock!

—Ewing Galloway.

About half a horsepower is pent up behind this bowstring, ready to flash the arrow to its mark. A good bow takes muscle to draw.

—Ewing Galloway.

If one of these Japanese national wrestlers picks up his opponent, weight 180 lbs., and throws him ten feet, how many foot-pounds of energy does he develop? Better than a horsepower!

When this pretty fraulein from Frankfort "leans on it" the discus simply has to go places!

in Sports

In getting distance into a discus-throw or in tossing an opponent to the mat, strength is not everything. Scientific skill must be employed. Do you know the secrets these champions employ to win?

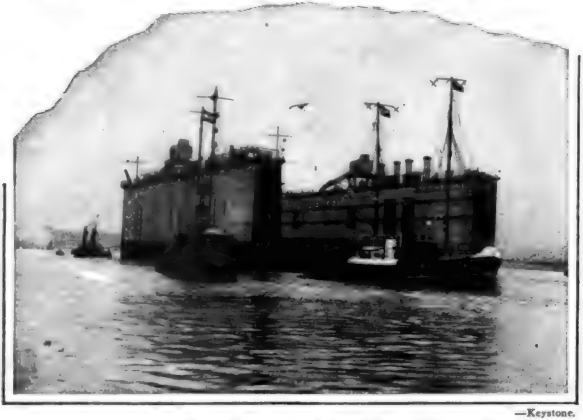
Springs in this device are guaranteed to put a thrill into broad jumping. They store up power and put a real kick into the jump.

A shark can swim a mile in 2 minutes. That's steaming! Arne Borg is a shark at swimming.

—Ewing Galloway.

In the Icelandic "Glima," national wrestling game of Iceland, harnesses are applied right at the center of gravity of the body, making it extremely difficult to throw an opponent and know which way he will fall.

Largest Dry Dock Starts Long Journey



—Keystone.

The largest floating dock in the world is shown leaving London on its 8,000-mile journey to Singapore.

FOUR powerful tugs are required to handle a single section of the largest floating dock in the world, just built for the British Admiralty. The dock will weigh 50,000 tons when completed. It is shown starting on its 8,600 mile journey to Singapore, a trip which is expected to take five months to complete.

The tugs were connected to the dock by 20-inch manila rope, used in preference to steel cable because of its greater elasticity. On its long journey the dock must pass through the Suez Canal, which is expected to afford a test of the navigator's skill because of its narrow clearance.

Ten Dollar Boat *wins* Outboard Trophy

SKILLFUL seamanship in a leaky canvas boat which he rescued from the junk heap won for Capt. E. E. Dunn of St. Petersburg, Fla., the Gondolier trophy in the recent outboard regatta at Miami.

Capt. Dunn bought his boat for $10. It was canvas covered, full of holes and utterly unseaworthy. Liberal use of graphite, lacquer and box-wood was necessary to make it water-tight. For fifty cents Capt. Dunn rented an outboard motor, and with this modest equipment pitted himself against some of the fastest and most costly boats in the country.

Gar Wood and other noted outboard racers were forced to trail in the wake of Capt. Dunn's renovated speedster. The heats were run off in rough water and upsets were numerous, but Capt. Dunn handled his craft so skillfully that he glided over the whitecaps an easy winner.

NOVEL STARTER *for* AIRPLANE ENGINE

—International Newsreel.

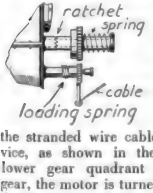
Lady Heath welcomed home from Capetown tour. She found the self-starter helpful.

Dangerous cranking of the propeller is eliminated by an ingenious self-starter operated from the airplane cockpit.

A SELF-STARTER operated from the cockpit is a feature of the British-built Cirrus airplane engine which powered the Avro biplane piloted by Lady Heath on her recent solo flight from London to Capetown.

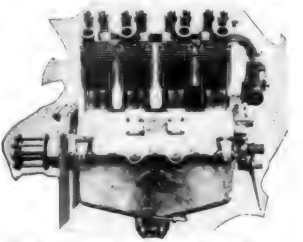
Instead of the dangerous cranking of the propeller with its ever-present danger of becoming entangled in the blade, the pilot equipped with a Cirrus motor turns his engine over from the dashboard.

The manual starter is extremely light in weight and operates from the cockpit, just as do some cable-mechanical emergency dashboard brakes. A rope is pulled and the motor ticks over.



In effecting this, a simple mechanism is used. It consists of a train of two spur gears which are out of mesh until the pilot pulls the stranded wire cable leading to the device, as shown in the drawing. As the lower gear quadrant engages the upper gear, the motor is turned over. On starting, the increased speed of the upper crankshaft causes the dog to slip, allowing the spring loaded arm to swing back to normal. Then the upper gear settles into the dog or ratchet clutch and the operating cycle is completed.

The Cirrus is a reliable engine of high efficiency, weighing only 245 pounds. The cylinders are of composite construction, the sleeve of the cylinder proper being made of high grade grain cast iron, and the heads of an alloy of aluminum containing magnesium and copper in small proportions.



Cirrus airplane motor, with starter shown attached at right, indicated by arrow.

The valve operation is almost identical with that of the familiar American Chevrolet motor. The push rods are of the same size and are adjusted in the same manner. Valve springs are double helical to avoid total failure through breakage in the air.

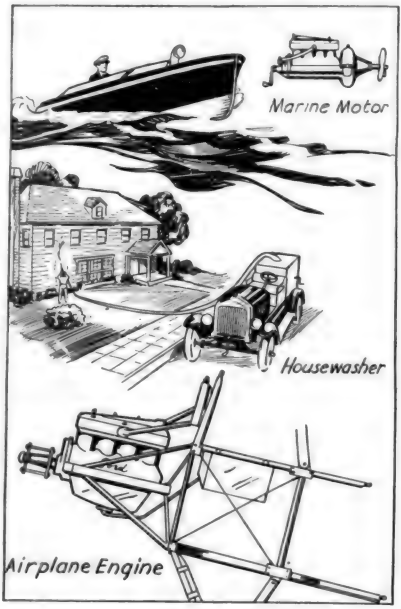
Should the air tourist need repairs, they can be effected by a handy mechanic in almost any corner of the earth. The Cirrus engine is notable for its simplicity, and its dependability was amply demonstrated by Lady Heath's 8,000-mile flight over Africa.

New Uses for OLD FORDS

SINCE the Ford Motor Company has ceased production on the universally known model T Ford car, millions of which are to be found in every corner of the world, many of these cars have drifted prematurely to vacant lots and garage junk heaps as an expectant public floods the Ford plant with a deluge of orders for the successor to the old design.

Does this mean that Tin Lizzie has served the last days of her utilitarian life? On the contrary!

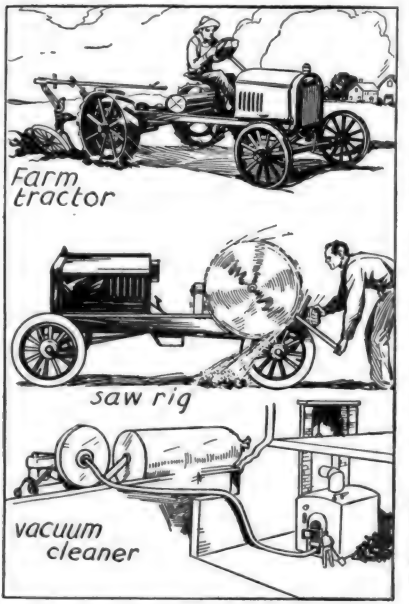
New uses for the "cast iron wonder" are being found daily wherever a need for extremely cheap and husky power comes up. In motorboats, converted tractors, power sleds, saw rigs, pump and well drilling outfits the familiar bulk of the gasoline heart of old Tin Lizzie is seen more and more often these days. They are even being made into airplane engines!



The Ford model T motor can be bought for a price from $5 or $10 up to $25, depending upon condition. No matter how worn, no matter how ready to "kick the bucket" the engine may be, repairs are to be had at the usual low prices in every garage. This will be the case for many years to come, for the parts replacement business of the Ford Motor Company is a huge industry in itself. So no matter what the condition of the engine of old model T, it can be bought with the assurance that it will provide serviceable power for years to come and can be put in running condition at a low cost.

One of the uses to which the Ford engine has been put with very satisfactory results is in the propulsion of boats. Developing 12 h. p. at 1,000 r. p. m. the engine makes a very good power plant for driving runabouts, launches and small cruisers. Placed in an eighteen foot runabout, a speed of

Rescued from a grave in the junk heap, Tin Lizzie dons working clothes and makes money for the ingenious man who thinks of new ways to use her cheap and ample power.



about eighteen miles an hour is readily obtained turning a 14-inch diameter by 16-inch pitch propeller wheel of three blades. A speed of eight to ten miles has been obtained in a fairly heavy open launch of 25 feet in length using a 16-inch diameter by 16-inch pitch three blade propeller. Boats as large as thirty-five footers have been driven seven to eight miles an hour by the Ford motor hooked to a 16-inch diameter by 14-inch pitch wheel.

As it is a unit power plant, there is very little alteration needed to make a motorboat engine out of the Ford motor. One of the most effective ways of converting the mill from automobile to marine use is to install the motor together with the frame on the usual wooden engine beds such as are built into the boat. The illustration shows this method plainly.

A four-inch Lobee gear pump obtainable from any marine hardware house will fit the crank-saddle bolt to perfection, and a coupling for driving it can be made by drilling the timer housing and running the shaft through on a specially made small timer nut. This cares for the cooling water system.

Fitted with steel wheels, with tractor lugs and an extreme low gear attachment, many an old Tin Elizabeth is now grinding out the last hours of her existence in some truck gardener's potato patch, doing light work like harrowing, drawing the cultivator, and hauling spray outfits. If the soil is not too heavy these tractors will even do a creditable job of pulling a single bottom with ease.

As a tractor, aside from the changes mentioned, the only additional equipment needed is the belt driven type of pump, needed to circulate the water faster, thus cutting down on oil consumption.

Have you a new use for an old Ford? For all ideas published the editors of Modern Mechanics will pay five dollars—with a bonus for photos. Send in your ideas, giving full details.

As a saw rig, very little is needed in the way of additional equipment that the local blacksmith cannot make. Many builders of the type of saw outfit shown in the drawing mount their rigs on a wagon, making the tilting table detachable, and the entire outfit is then a portable saw mill which can be taken from place to place to rapidly and profitably convert logs into cordwood.

The bearings shown in the drawing may be ordinary pillow blocks with babbitt bearings. The saw is generally belted to run half again as fast as the engine, or about 1,800-2,100 r. p. m. and can be bought in two foot diameters from most any hardware store. This will give ample saw speed without overloading the engine.

Many men in the wooded farming sections of the northwest make comfortable winter livings with these saw outfits.

One enterprising Eastern schoolboy made a vacuum pump as shown, rigged it on a neat steel wagon, and set about building up a vacuum cleaning service for houses in which he drives up to the curb, runs a large canvas covered tube into the basement of the home, and proceeds to load his wagon with the rubbish in the basement, cleaning up ashes, paper, cans and cobwebs. He tops off the job by thoroughly cleaning the furnace and sweeping the soot from the chimney with the suction! The entire lot of dirt is delivered into an inflated canvas sack just as is seen in a vacuum cleaner. In this case the bag is on a larger scale.

He receives $7 for the service, which takes half a day. He supervises and directs the vacuum pickup, while the heart of an old Tin Lizzie does the work!

House Washing by Machine

Similar in nature is the mounting development by a Chicago man for washing houses. The ordinary house faucet or lawn hose water pressure has not enough force to separate the winter's grime from the ordinary painted surface, with the consequent result that in the springtime Mr. Average Man tries out the hose, decides the house must be hand washed, and if he is not particularly observing, comes to the final conclusion that to appear neat and trim after a winter of smoke and grime his house must be painted. This costs money, and a man who drives up with a geared force pump, a set of ladders, and a long handled scrubbing brush has no trouble securing the job of washing the house, particularly as the cost of freshening the looks of the home with his method is but $25, whereas new paint entails much muss and fuss and at least an outlay of $75.

With soap, brush and ladders this man quickly wets down the dirt, scrubbing loose the most obstinate deposits from cornice corners, and then, cranking up Elizabeth, he stands off with a pressure hose and rinses the dissolved smudge from the entire home, taking care not to rip up shingles or blow in windows. The paint does not suffer from this treatment, but emerges bright and glossy. Profit is said to be in the neighborhood of $10, over and above the cost of a man's time and the soap used.

At the rate of two jobs a day a profitable business is easily built up. The idea is just spreading to various cities, and there is little competition except the old fashioned strong arm method.

Other uses that have been found for Ford motors and old chassis have been discovered in profusion on the farm. As shown in the illustrations creditable drilling rigs have been made up from old parts, while the wheels, axles and entire frames have been converted into rubber-tired trailers in which the stock is hauled to market.

Even airplanes have been flown with this motor! When geared by chain to a propeller of the required efficiency, generally 5½ foot pitch and six foot diameter, a static thrust of 275 lbs. can be developed which will fly several planes now being built and for which blueprints are available.

Thus, though new model Fords are appearing in increasing numbers on the highways of the country, new uses for the old reliable Model T Ford engine will continue to be found.

Adrien Remy, French engineer, has completed his double-pontoon boat for crossing the Atlantic in 60 hours.

The tank-like cabin carries fuel and a crew of six men. A 650 horsepower engine gives a speed of 70 knots.

Cheating TIME *on the* NORTH ATLANTIC

Crossing the Atlantic in 60 hours is the feat claimed possible by Remy, inventor of an ocean hydroglider! Contrast this with methods of travel as developed in the last two hundred years.

SPEED! Speed!! Speed!!

Ever since the Pilgrims set foot on Plymouth Rock—ever since the days when Virginia was first colonized, there has been the cry among shippers for greater speed in crossing the stormy North Atlantic!

Ships have grown in size and have varied greatly in type since Colonial days. From the ships of the Mayflower era with their "record breaking" trips of 80 days, down to present day liners and speedy aircraft, the one thought uppermost in the minds of men has been the reduction of time consumed in crossing the water barrier between the capitals of the old and New Worlds. At present shipping men are fired with the dreams of wealth which are sure to be showered upon the engineer who will furnish the best and *most reliable* way of crossing the Atlantic in what is termed "airplane time."

So it is that one of these days natives of New York may be surprised to see, racing up the harbor past Governor's Island, a queer looking hydro-glider. Flashing to the Battery at 70 knots an hour, it is pos-

Pilgrim ships took two months to cross.

sible that this strange craft will dock in the New World but 60 hours from Cherbourg. Behind the actual accomplishment of this feat will be the romantic story of shipping development—the story of scudding sailing ships, hard driving masters, the story of colossal liners with hearts of steel, and of patient, obscure thinkers who make these advances possible.

It is a far cry from the crude machinery of James Watt, who built the first marine steam engine for crossing the Atlantic, to the modern floating palaces which are shortly to be superseded in their four day schedule by faster means of carrying precious documents, gold, and letters of state between the two world centers. It is a still further cry from ships of Columbus' time, of Hendrik Hudson's time, to the new R-100, the British dirigible, and to the Remy surface hydro-glider.

Behind all the development which has taken place in cutting hours and minutes from inter-continental schedules there has ever been the urgent cry for *speed, more speed!*

Before the days of the trans-Atlantic cable, there was a great premium paid to owners of ships that could bring to the new world freights of a perishable nature in the lowest elapsed time. News, bank clearings, and the intricate documents of international banking were carried on specially constructed ships which earned fortunes for their owners. It was such competition which forced the development of the first steamers, and drove the less efficient sails from the seas. *Speed, more speed!*

Why Speed?

Why? Because "there is money in it," as the hard headed men of business say. They have learned that trans-Atlantic trade showers rich returns on the man who devises the quickest means for bringing the continents closer together.

It is true that the

By sail and steam the Savannah made it in 27 days.

The mighty Mauretania requires about four days—too long!

cable eased the burden of the ships somewhat, but after the cable had been laid and news was being rushed undersea with the speed of light, gold still had to be carried, international banking clearances were being held up pending arrival of money shipments at their destinations, and the formal processes of government were rendered all the more sluggish for each extra hour consumed in bringing mail and express matter from one side to the other.

The building of such fast mail and passenger steamers as the Mauretania, the Olympic, Berengaria, and Leviathan seemed the ultimate in ocean transportation. When they were built, the airplane was a back lot toy. It was hardly worthy of even military recognition, and certainly not considered as a possible means for hopping the Atlantic with any degree of reliability.

Though airplanes have spanned the ocean, the fact remains that planes today have not developed to such an extent that they are reliable transports. Business will not yet trust valuable express matter and shipments of gold to airplanes. Though planes will cross the sea in 35 hours, they are not capable of carrying payloads reliably. For the present they are out of the picture as far as an improvement in trans-oceanic express work is concerned.

Remy's hydroglider is latest link in progress pageant.

The dirigible is considered by many as too fragile for 30 hour trans-ocean flights.

Will the seaplane of tomorrow look like this? Will it be dependable?

But there is at present, actually built and ready for a trial trip, a queer design for a trans-oceanic speed boat which was constructed by Adrien Remy, a French engineer. Built on the banks of the Seine at the Saint-Ouens marine works, the odd craft was given her trials early this year at the little town of Javel. A proposed trip to prove her the ultimate type of trans-oceanic speed carrier is planned for the early winter.

CONQUEST of the MOON

(PART I)

MY NAME is Julian. I am called Julian 5th. I come of an illustrious family —my great-great-grandfather, Julian 1st, a major at twenty-two, was killed in France early in The Great War. My great-grandfather, Julian 2nd, was killed in battle in Turkey in 1938. My grandfather, Julian 3rd, fought continuously from his sixteenth year until peace was declared in his thirtieth year.

At sixteen I graduated from the Air School and was detailed to the International Peace Fleet, being the fifth generation of my line to wear the uniform of my country. That was in 2016, and I recall that it was a matter of pride to me that it rounded out the full century since Julian 1st graduated from West Point, and that during that one hundred years no adult male of my line had ever owned or worn civilian clothes.

Of course there were no more wars, but there still was fighting. We had the pirates of the air to contend with and occasionally

The crew of THE BARSOOM watched helplessly, unable to aid their comrades in their unequal struggle.

by Edgar Rice Burroughs
Author of "TARZAN"

IN THIS breathless serial of the adventures of five men marooned in the center of the moon, Edgar Rice Burroughs outdoes even his previous deservedly famous tales. Beset by strange, half-human animals, the earth men struggle for their lives in a queer world of red grass and perpetual day, where the Men in the Moon are not the least of the many dangers.

some of the uncivilized tribes of Russia, Africa and central Asia required the attention of a punitive expedition. There wasn't a firearm in the world other than those with which we were armed, and a few of ancient design that were kept as heirlooms, or in museums, or that were owned by savage tribes who could procure no ammunition for them, since we permitted none to be manufactured. There was not a gas shell nor a radio bomb, nor any engine to discharge or project one; and there wasn't a big gun of any calibre in the world. I veritably believed that a thousand men equipped with the various engines of destruction that had reached their highest efficiency at the close of the war in 1967 could have conquered the world; but there were not a thousand men so armed—there never could be a thousand men so equipped anywhere upon the face of the Earth.

But it seems that Providence never intend-

Attacked by the ferocious Va-gas — half-horse, half-human beings from the center of the Moon — the men from the earth fight desperately for their lives.

The hostile beast-man reared and clutched his spear menacingly as Orthis drew a bead.

ed that the world should be without calamities. If man prevented those of possible internal origin there still remained undreamed of external sources over which he had no control. It was one of these which was to prove our undoing. Its seed was sown thirty-three years before I was born, upon that historic day, June 10th, 1967, that Earth received her first message from Mars, since which the two planets have remained in constant friendly communication, carrying on a commerce of reciprocal enlightenment.

In some branches of the arts and sciences the Martians, or Barsoomians, as they call themselves, were far in advance of us, while in others we had progressed more rapidly than they. Knowledge was thus freely exchanged to the advantage of both worlds.

Martian news held always a prominent place in our daily papers from the first.

The Earth Talks to Mars

THEY helped us most, perhaps, in the fields of medicine and aeronautics, giving us in one, the marvelous healing lotions of Barsoom and in the other, knowledge of the Eighth Ray, which is more generally known on Earth as the Barsoomian Ray, which is now stored in the bouyancy tanks of every air craft and has made obsolete those ancient types of plane that depended upon momentum to keep them afloat.

That we ever were able to communicate intelligibly with them is due to the presence upon Mars of that deathless Virginian, John Carter, whose miraculous transportation to Mars occurred March 4th, 1866, as every school child of the twenty-first century knows. It was he who evolved the present inter-planetary code.

Almost from the first the subject which engrossed us all the most was the possibility of an actual exchange of visits between Earth Men and Barsoomians. Each planet hoped to be the first to achieve this, yet neither withheld any information that would aid the other in the consummation of the great fact. We had the Eighth Ray, the motors, the oxygenating devices, the insulating processes—everything to insure the safe and certain transit of a specially designed air craft to Mars, were Mars the only other inhabitant of space. But it was not and it was the other planets and the Sun that we feared.

In 2015 Mars had dispatched a ship for Earth with a crew of five men provisioned for ten years. It was hoped that with good luck the trip might be made in something less than five years, as the craft had developed an actual trial speed of one thousand miles per hour. At the time of my graduation the ship was already off its course almost a million miles and generally conceded to be hopelessly lost.

We had had a ship about ready at the time of the sailing of the Martians, but the government at Washington had forbidden the venture when it became apparent that the Barsoomian ship was doomed—a wise decision, since our vessel was no better equipped than theirs. Nearly ten years elapsed before anything further was accomplished in the direction of assuring any greater hope of success for another inter-planetary venture into space, and this was directly due to the discovery made by a former classmate of mine, Lieutenant Commander Orthis, one of the most brilliant men I have ever known, and at the same time one of the most unscupulous, and, to me at least, the most obnoxious.

Orthis Isolates the Eighth Ray

WE HAD entered the Air School together —he from New York and I from Illinois—and almost from the first day we had seemed to discover a mutual antagonism that, upon his part at least, must have been considerably strengthened by numerous unfortunate occurrences during our four years beneath the same roof. In the first place he was not popular with either the cadets, the instructors, or the officers of the school, while I was most fortunate in this respect. In the class room he outshone us all—even the instructors were amazed at the brilliancy of his intellect—and yet as we passed from grade to grade I often topped him in the final examinations. I ranked him always as a cadet officer, and upon graduation I took a higher grade among the new ensigns than he.

From then on I saw little of him, his services confining him principally to land service, while mine kept me almost constantly on the air in all parts of the world. Occasionally I heard of him—usually some-

thing unsavory; he had married a nice girl and abandoned her—there had been talk of an investigation of his accounts—and the last that there was a rumor that he was affiliated with a secret order that sought to overthrow the government.

And during these nine years since graduation, as we had drifted apart in interests, so had the breach between us been widened by constantly increasing difference in rank. He was a Lieutenant Commander and I a Captain, when in 2024 he announced the discovery and isolation of the Eighth Solar Ray, and within two months those of the Moon, Mercury, Venus and Jupiter. The Eighth Barsoomian and the Eighth Earthly Rays had already been isolated, and upon Earth the latter erroneously called by the name of the former.

Orthis' discoveries were hailed upon two planets as the key to actual travel between the Earth and Barsoom, since by means of these several rays the attraction of the Sun and the planets could be definitely overcome and a ship steer a direct and unimpeded course through space to Mars.

Orthis wanted to equip a ship and start at once, but again the government intervened and forbade what it considered an unnecessary risk. Instead Orthis was ordered to design a small radio operated flier, which would carry no one aboard, and which it was believed could be automatically operated for at least half the distance between the two planets. After his designs were completed, you may imagine his chagrin, and mine as well, when I was detailed to supervise construction, yet I will say that Orthis hid his natural emotions well and gave me perfect cooperation in the work we were compelled to undertake together. On my part I made it as easy for him as I could, working with him rather than over him.

The Barsoom Takes Off for Mars

IT WAS late in 2024 that the ship was launched upon its strange voyage, and almost immediately, upon my recommendation, work was started upon the perfection of the larger ship. Orthis was again my assistant, and with the means at our disposal it was a matter of less than eight months before *The Barsoom*, as she was christened, was completely overhauled and thoroughly equipped for the interplanetary voyage.

The various eighth rays that would assist us in overcoming the pull of the Sun, Mercury, Venus, Earth, Mars and Jupiter were stored in carefully constructed and well protected tanks within the hull, and there was a smaller tank at the bow containing the Eighth Lunar Ray, which would permit us to pass safely within the zone of the moon's influence without danger of being attracted to her barren surface.

Our own experimental ship had been speeding upon its lonely way now for eight months, and so accurate had Orthis' scientific deductions proven that the most delicate instrument could detect no slightest deviation from its prescribed course. It was then that Orthis began to importune the government to permit him to set out with the new craft that was now completed. The authorities held out, however, until the latter part of 2025 when, the experimental ship having been out a year and still showing no deviation from its course, they felt reasonably assured that the success of the venture was certain.

The Barsoom required five men properly to handle it, and as had been the custom through centuries when an undertaking of more than usual risk was to be attempted, volunteers were called for, with the result that fully half the personnel of the International Peace Fleet begged to be permitted to form the crew of five.

The government finally selected their men from the great number of volunteers, with the result that once more was I the innocent cause of disappointment and chagrin to Orthis, as I was placed in command, with Orthis, two lieutenants and an ensign completing the roster.

The Barsoom was larger than the craft dispatched by the Martians, with the result that we were able to carry supplies for fifteen years. We were equipped with more powerful motors which would permit us to maintain an average speed of over twelve hundred miles an hour, carrying in addition an engine recently developed by Orthis which generated sufficient power from light to propel the craft at half-speed in the event that our other engine should break down.

Our farewells were made at an elaborate ball at the White House on December 24,

2025, and on Christmas day we rose from the landing stage at which *The Barsoom* had been moored, and amid the blare of bands and the shouting of thousands of our fellow countrymen we arose majestically into the blue.

Equipment of The Barsoom

I SHALL not bore you with dry, technical descriptions of our motors and equipment. Suffice it to say that the former were of three types—those which propelled the ship through the air and those which propelled it through ether, the latter of course represented our most important equipment, and consisted of powerful multiple-exhaust separators which isolated the true Barsoomian Eighth Ray in great quantities, and, by exhausting it rapidly earthward, propelled the vessel toward Mars. These separators were so designed that, with equal facility, they could isolate the Earthly Eighth Ray which would be necessary for our return voyage.

The auxiliary engine, which I mentioned previously and which was Orthis' latest invention, could be easily adjusted to isolate the eighth ray of any planet or satellite or of the sun itself, thus insuring us motive power in any part of the universe by the simple expedient of generating and exhausting the eighth ray of the nearest heavenly body. A fourth type of generator drew oxygen from the ether, while another emanated insulating rays which insured us a uniform temperature and external pressure at all times, their action being analogous to that of the atmosphere surrounding the earth.

Had it not been for Orthis' presence I could have looked forward to a reasonably pleasurable voyage, for West and Jay were extremely likable fellows and sufficiently mature to be companionable, while young Norton, the ensign, though but seventeen years of age, endeared himself to all of us from the very start of the voyage by his pleasant manners, his consideration and his willingness in the performance of his duties. There were three staterooms aboard *The Barsoom*, one of which I occupied alone, while West and Orthis had the second and Jay and Norton the third.

West and Jay were lieutenants and had been classmates at the air school. They would of course have preferred to room together, but could not unless I commanded it or Orthis requested it. Not wishing to give Orthis any grounds for offense I hesitated to make the change, while Orthis, never having thought a considerate thought or done a considerate deed in his life, could not, of course, have been expected to suggest it. We all messed together, West, Jay and Norton taking turns at preparing the meals. Only in the actual operation of the ship were the lines of rank drawn strictly. Otherwise we associated as equals.

We had books and writing materials and games, and we were, of course, in constant radio communication with both Earth and Mars, receiving continuously the latest news from both planets. There was always a certain constraint in Orthis' manner toward me, yet I must give him credit for behaving outwardly admirably. Unlike the others we never exchanged pleasantries with one another, nor could I, knowing as I did that Orthis hated me, and feeling for him personally the contempt that I felt because of his character. Intellectually he commanded my highest admiration, and upon intellectual grounds we met without constraint or reserve.

Studying the Vegetation of the Moon

IT WAS about the second day that I noticed with some surprise that Orthis was exhibiting a friendly interest in Norton. Orthis was a good talker. He knew his profession thoroughly, and was an inventor and scientist of high distinction. Norton, though but a boy, was himself the possessor of a fine mind. He had been honor-man in his graduating class, heading the list of ensigns for that year, and I could not help but notice that he was drinking in every word along scientific lines that Orthis vouchsafed.

We had been out about six days when Orthis came to me and suggested, that inasmuch as West and Jay had been classmates and chums that they be permitted to room together and that he had spoken to Norton who had said that he would be agreeable to the change and would occupy West's bunk in Orthis' stateroom. I was very glad of this for it now meant that my subordinates would be paired off in the most agreeable manner, and as long as they were contented,

I knew that the voyage from that standpoint at least would be more successful.

We were beginning to feel the influence of the Moon rather strongly. At the rate we were traveling we would pass closest to it upon the twelfth day, or about the 6th of January, 2026.

Our course would bring us within about twenty thousand miles of the Moon, and as we neared it I believe that the sight of it was the most impressive thing that human eye had ever gazed upon before. To the naked eye it loomed large and magnificent in the heavens, appearing over ten times the size that it does to terrestrial observers, while our powerful glasses brought its weird surface to such startling proximity that one felt that he might reach out and touch the torn rocks of its tortured mountains.

Our eyes were first attracted by what appeared to be movement upon the surface of some of the valleys and in the deeper ravines of the mountains. Norton exclaimed that there were creatures there, moving about, but closer observation revealed the fact of the existence of a weird fungus-like vegetation which grew so rapidly that we could clearly discern the phenomena. From the spore it developed in the short period of a trifle over twenty-seven days into a mighty plant that is sometimes hundreds of feet in height.

The branches are angular and grotesque, the leaves broad and thick, and in the plants which we discerned the seven primary colors were distinctly represented. As each portion of the Moon passed slowly into shadow the vegetation first drooped, then wilted, then crumbled to the ground, apparently disintregrating almost immediately into a fine, dust-like powder—at least in so far as our glasses revealed, it quite disappeared entirely. The movement which we discerned was purely that of rapid growth, as there is no wind upon the surface of the Moon. Both Jay and Orthis were positive that they discerned some form of animal life, either insect or reptilian. These I did not myself see, though I did perceive many of the broad, flat leaves which seemed to have been partially eaten.

The Other Side of the Moon

I PRESUME that one of the greatest thrills that we experienced in this adventure, that was to prove a vertiable Pandora's box of thrills, was when we commenced to creep past the edge of the Moon and our eyes beheld for the first time that which no other human eyes had ever rested upon—portions of that two-fifths of the Moon's surface which is invisible from the Earth.

I cannot say that it differed materially from that portion of the Moon that is visible to us—it was merely the glamour of mystery which had surrounded it since the beginning of time that lent to it its thrill for us. Here we observed other great mountain ranges and wide undulating plains, towering volcanoes and mighty craters and the same vegetation with which we were now become familiar.

We were two days past the Moon when our first trouble developed. Among our stores were one hundred and twenty quarts of spirits per man, enough to allow us each a liberal two ounces per day for a period of five years. Each night, before dinner we drank to the President in a cocktail which contained a single ounce of spirits, the idea being to conserve our supply in the event of our journey being unduly protracted as well as to have enough in the event that it became desirable fittingly to celebrate any particular occasion.

Toward the third meal hour of the thirteenth day of the voyage Orthis entered the messroom noticeably under the influence of liquor.

With the repeal of the Prohibition Act, nearly a hundred years ago, the habit of drinking to excess abated, so that it became a matter of disgrace for any man to show his liquor, and in the service it was considered as reprehensible as cowardice in action. There was therefore but one thing for me to do. I ordered Orthis to his quarters.

He was drunker than I had thought him, and he turned upon me like a tiger.

Mutiny!

"YOU damned cur," he cried. "All my life you have stolen everything from me; the fruits of all my efforts you have garnered by chicanery and trickery, and even now, were we to reach Mars, it is you who would be lauded as the hero—not I whose labor and intellect have made possible this achievement. But by God we will not reach Mars. You have gone too far this

time, and now you dare to order me about like a dog and an inferior—I, whose brains have made you what you are."

I held my temper, for I saw the man was unaccountable for his words. "Go to your quarters, Orthis," I repeated my command. "I will talk with you again in the morning."

West and Jay and Norton were present. They seemed momentarily paralyzed by the man's condition and gross insubordination. Norton, however, was the first to recover. Jumping quickly to Orthis' side he laid his hand upon his arm. "Come, sir," he said, and to my surprise Orthis accompanied him quietly to their stateroom.

Before breakfast on the following morning I sent for Orthis to come to my stateroom. He entered with a truculent swagger, and his first words indicated that if he had not continued drinking, he had at least been moved to no regrets for his unwarranted attack of the previous evening.

"Well," he said, "what in hell are you going to do about it?"

"I cannot understand your attitude, Orthis," I told him. "I have never intentionally injured you. When orders from the government threw us together I was as much chagrined as you. I merely did as you did—obeyed orders. I have no desire to rob you of anything, but that is not the question now. You have been guilty of gross insubordination and of drunkenness. I can prevent a repetition of the latter by confiscating your liquor and keeping it from you during the balance of the voyage, and an apology from you will atone for the former. I shall give you twenty-four hours to reach a decision. If you do not see fit to avail yourself of my clemency, Orthis, you will travel to Mars and back again in irons. And I tell you, Orthis, that if I possibly can do so I shall use the authority which is mine upon this expedition and expunge from the log the record of your transgressions last night and this morning. Now go to your quarters; your meals will be served there for twenty-four hours and at the end of that time I shall receive your decision. Meanwhile your liquor will be taken from you."

He gave me an ugly look, turned upon his heel and left my stateroom.

Destruction!

NORTON was on watch that night. We were two days past the Moon. West, Jay and I were asleep in our staterooms, when suddenly Norton entered mine and shook me violently by the shoulder.

"My God, Captain," he cried, "come quick. Commander Orthis is destroying the engines."

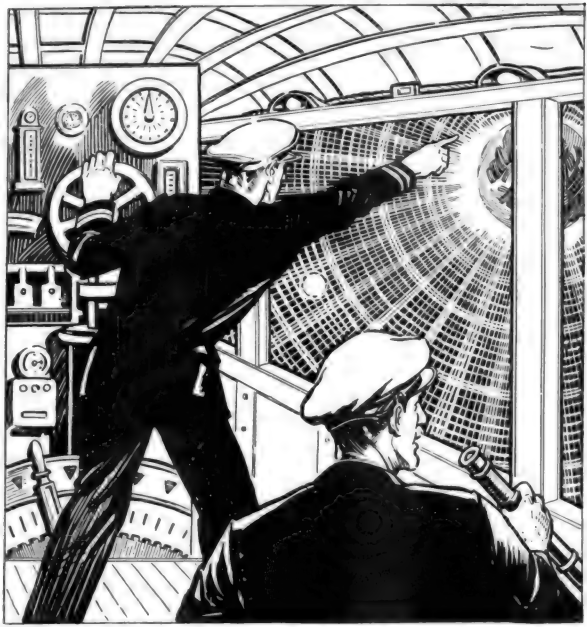
I leaped to my feet and followed Norton amidship to the engine-room, calling to West and Jay as I passed their stateroom. Through the bull's-eye in the engine-room door, which he had locked, we could see Orthis working over the auxiliary generator which was to have proven our salvation in an emergency. I breathed a sigh of relief as my eyes noted that the main battery of engines was functioning properly, since, as a matter of fact, we had not expected to have to rely at all upon the auxiliary generator, having stored sufficient quantities of the Eighth Ray of the various heavenly bodies by which we might be influenced, to carry us safely throughout the entire extent of the long voyage. West and Jay had joined us by this time, and I now called to Orthis, commanding him to open the door. He did something more to the generator and then arose, crossed the engine-room directly to the door, unbolted it and threw the door open. His hair was dishevelled, his face drawn, his eyes shining with a peculiar light.

"What have you been doing here, Orthis?" I demanded. "You are under arrest, and supposed to be in your quarters."

"You'll see what I've been doing," he replied truculently, "and it's done—it's done—it can't ever be undone. I've seen to that."

I grabbed him roughly by the shoulder. "What do you mean? Tell me what you have done, or by God I will kill you with my own hands," for I knew, not only from his words but from his expression, that he had accomplished something which he considered very terrible.

The man was a coward and he quailed under my grasp. "You wouldn't dare to kill me," he cried, "and it don't make any difference, for we'll all be dead in a few hours. Go and look at your damned compass."



The invisible tentacles of Lunar gravity clutched the helpless BARSOOM.

In the Grasp of the Moon

NORTON, whose watch it was, had already hurried toward the pilot room where were located the controls and the various instruments. This room, which was just forward of the engine-room, was in effect a circular conning-tower which projected about twelve inches above the upper hull. The entire circumference of this twelve-inch superstructure was set with small ports of thick crystal glass.

As I turned to follow Norton I spoke to West. "Mr. West," I said, "you and Mr. Jay will place Lieutenant Commander Orthis in irons immediately. If he resists, kill him."

When I reached the pilot house I found Norton working very quietly with the controls. There was nothing hysterical in his movements, but his face was absolutely ashen.

"What is wrong, Mr. Norton?" I asked. But as I looked at the compass simultaneously I read my answer there before he spoke. We were moving at right angles to our proper course.

"We are falling toward the Moon, sir," he said, "and she does not respond to her control."

"Shut down the engines," I ordered, "they are only accelerating our fall,"

"Aye, aye, sir," he replied.

"The Lunar Eighth Ray tank is of sufficient capacity to keep us off the Moon," I said. "If it has not been tampered with, we should be in no danger of falling to the Moon's surface."

"If it has not been tampered with, sir; yes, sir, that is what I have been thinking."

"But the gauge here shows it full to capacity," I reminded him.

"I know sir," he replied, "but if it were full to capacity, we should not be falling so rapidly."

Immediately I fell to examining the gauge, almost at once discovering that it had been tampered with and the needle set permanently to indicate a maximum supply. I turned to my companion.

"Mr. Norton," I said, "please go forward and investigate the Lunar Eighth Ray tank, and report back to me immediately."

The young man saluted and departed. As he approached the tank it was necessary for him to crawl through a very restricted place beneath the deck.

In about five minutes Norton returned. He was not so pale as he had been, but he looked very haggard.

"Well?" I inquired as he halted before me.

"The exterior intake valve has been opened, sir," he said, "the rays were escaping into space. I have closed it, sir."

We Lose the Earth Forever

THE valve to which he referred was used only when the ship was in dry dock, for the purpose of refilling the bouyancy tank, and, was placed in an inaccessible part of the hull where there was absolutely no likelihood of its being accidentally opened.

Norton glanced at the instrument. "We are not falling quite so rapidly now," he said.

"Yes," I replied, "I had noted that, and I have also been able to adjust the Lunar Eighth Ray gauge—it shows that we have about half the original pressure."

"Not enough to keep us from going aground," he commented.

"No, not here, where there is no atmosphere. If the Moon had an atmosphere we could at least keep off the surface if we wished to. As it is, however, I imagine that we will be able to make a safe landing, though, of course that will do us little good. You understand, I suppose, Mr. Norton, that this is practically the end."

He nodded. "It will be a sad blow to the inhabitants of two worlds," he remarked, his entire forgetfulness of self indicating the true nobility of his character.

"It is a sad report to broadcast," I remarked, "but it must be done, and at once. You will, please, send the following message to the Secretary of Peace:

"U. S. S. *The Barsoom*, January 6, 2026, about twenty thousand miles off the Moon. Lieutenant Commander Orthis, while under the influence of liquor, has destroyed auxiliary engine and opened exterior intake valve Lunar Eighth Ray bouancy tank. Ship sinking rapidly. Will keep you——"

Norton who had seated himself at the radio desk leaped suddenly to his feet and turned toward me. "My God, sir," he cried, "he has destroyed the radio outfit also. We can neither send nor receive."

A careful examination revealed the fact that Orthis had so cleverly and completely destroyed the instruments that there was no hope of repairing them. I turned to Norton.

"We are not only dead, Norton, but we are buried, as well."

I smiled as I spoke and he answered me with a smile that betokened his utter fearlessness of death.

"I have but one regret, sir," he said, "and that is that the world will never know that our failure was not due to any weakness of our machinery, ship or equipment."

"That is, indeed, too bad," I replied, "for it will retard transportation between the two worlds possibly a hundred years—maybe forever."

We Drop to the Moon

I CALLED to West and Jay who by this time had placed Orthis in irons and confined him to his stateroom. When they came I told them what had happened, and they took it as coolly as did Norton.

Together we immediately made a careful inspection of the ship, which revealed no further damage than that which we had al-

ready discovered, but which was sufficient as we well knew, to preclude any possibility of our escaping from the pull of the Moon.

"You gentlemen realize our position as well as I," I told them. "Could we repair the auxiliary generator we might isolate the Lunar Eighth Ray, refill our tank, and resume our voyage. But the diabolical cleverness with which Lieutenant Commander Orthis has wrecked the machine renders this impossible. It is my plan, therefore, to make a landing. In so far as the actual lunar conditions are concerned, we are confronted only by a mass of theories. It will, therefore, be at least a matter of consuming interest to us to make a landing upon this dead world where we may observe it closely. At least we can be no worse off.

"To live for fifteen years cooped in the hull of this dead ship is unthinkable. Had Orthis not destroyed the radio outfit we could have communicated with Earth and another ship been outfitted and sent to our rescue inside a year. But now we cannot tell them, and they will never know our fate. The emergency that has arisen has, however, so altered conditions that I do not feel warranted in taking this step without consulting you gentlemen. I wish, therefore, that you would express yourselves freely concerning the plan which I have outlined."

West, who was the senior among them, was naturally the one to reply first. He told me that he was content to go wherever I led, and Jay and Norton in turn signified a similar willingness to abide by whatever decision I might reach. They also assured me that they were as keen to explore the surface of the Moon at close range as I, and that they could think of no better way of spending the remainder of their lives than in the acquisition of new experiences and the observation of new scenes.

"Very well, Mr. Norton," I said, "you will set your course directly toward the Moon."

Drifting

AIDED by lunar gravity our descent was rapid.

As we plunged through space at a terrific speed, the satellite seemed to be leaping madly toward us, and at the end of fifteen hours I gave orders to slack off and brought the ship almost to a stop about nine thousand feet above the summit of the higher lunar peaks. Never before had I gazed upon a more awe-inspiring scene than that presented by those terrific peaks towering five miles above the broad valleys at their feet. Sheer cliffs of three and four thousand feet were nothing uncommon, and all was rendered weirdly beautiful by the variegated colors of the rocks and the strange prismatic hues of the rapidly-growing vegetation upon the valley floors.

From our lofty elevation above the peaks we could see many craters of various dimensions, some of which were huge chasms, three and four miles in diameter. As we descended slowly we drifted directly over one of these abysses, into the impenetrable depths of which we sought to strain our eyesight. Some of us believed that we detected a faint luminosity far below, but of that we could not be certain. Jay thought it might be the reflected light from the molten interior.

At this altitude we made an interesting discovery. There is an atmosphere surrounding the Moon. It is extremely tenuous, but yet it was recorded by our barometer at an altitude of about fifteen hundred feet above the highest peak we crossed. As the ship drifted we presently noted that it was taking a circular course paralleling the rim of the huge volcanic crater above which we were descending. I immediately gave orders to alter our course since, as we were descending constantly, we should presently be below the rim of the crater and, being unable to rise, be hopelessly lost in its huge maw.

It was my plan to drift slowly over one of the larger valleys as we descended, and make a landing amidst the vegetation which we perceived growing in riotous profusion and movement beneath us. But when West, whose watch it now was, attempted to alter the course of the ship, he found that it did not respond. Instead it continued to move slowly in a great circle around the inside rim of the crater. West looked up at us, smiled, and shook his head.

Caught in a Lunar Whirlpool

"IT IS no use, sir," he said, addressing me. "It is about all over, sir, and there won't be any shouting. We seem to

be caught in what one might call a lunar whirlpool, for you will have noticed, sir, that our circles are constantly growing smaller."

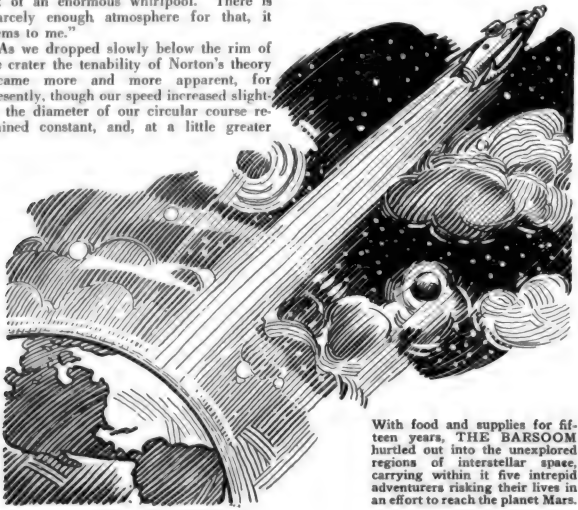
"Our speed does not seem to be increasing," I remarked, "as would follow were we approaching the vortex of a true whirlpool."

"I think I can explain it, sir," said Norton. "It is merely due to the action of the Lunar Eighth Ray which still remains in the forward buoyancy tank. Its natural tendency is to push itself away from the Moon, which, as far as we are concerned, is represented by the rim of this enormous crater. As each portion of the surface repels us in its turn we are pushed gently along in a lessening circle, because, as we drop nearer the summit of the peak the greater the reaction of the Eighth Lunar Ray."

"I guess you are right, Norton," I said. "At least it is a far more tenable theory than that we are being sucked into the vortex of an enormous whirlpool. There is scarcely enough atmosphere for that, it seems to me."

As we dropped slowly below the rim of the crater the tenability of Norton's theory became more and more apparent, for presently, though our speed increased slightly, the diameter of our circular course remained constant, and, at a little greater depth, our speed as well. We were descending now at the rate of a little over ten miles an hour, the barometer recording a constantly increasing atmospheric pressure. The temperature rose slightly, but not alarmingly.

During the next ten miles our speed diminished rapidly, until we suddenly realized that we were no longer falling, but that our motion had been reversed and we were rising. Up we went for approximately eight miles, when suddenly we began to fall again. Again we fell, but this time for only six miles, when our motion was reversed and we rose again a distance of about four miles. This see-sawing was continued until we finally came to rest at about what we estimated was a distance of some one hundred and thirty miles below the summit of the crater. It was quite dark, and we had only our instruments to tell us what was happening to the ship, the inte-



With food and supplies for fifteen years, THE BARSOOM hurtled out into the unexplored regions of interstellar space, carrying within it five intrepid adventurers risking their lives in an effort to reach the planet Mars.

Edgar Rice Burroughs has written his greatest story in this thrilling tale of breathless adventure in the heart of the Moon. Don't fail to read it!

Luna—weird inner world of prismatic vegetation, red grass, purple Moon Men—and the Moon Maid!

rior of which was, of course, brilliantly illuminated and comfortably warm.

The Hollow Moon

NOW below us, and now above us, for the ship had rolled completely over each time we had passed the point at which we came finally to rest, we had noted the luminosity that Norton had first observed from above the mouth of the crater. Each of us had been doing considerable thinking, and at last young Norton could contain himself no longer.

"I beg your pardon, sir," he said deferentially, "but won't you tell us what you think of it; what your theory is as to where we are and why we hang here in mid-air, and why the ship rolled over every time we passed this point?"

"I can only account for it," I replied, "upon a single and rather preposterous hypothesis, which is that the Moon is a hollow sphere, with a solid crust some two hundred and fifty miles in thickness. Gravity is preventing us from rising above the point where we now are, while centrifugal force keeps us from falling."

The others nodded. They too had been forced to accept the same apparently ridiculous theory, since there was none other that could explain our predicament. Norton had walked across the room to read the barometer and I saw him studying it carefully, as though to assure himself that he had made no mistake in the reading. Then he turned toward us.

"There must be something wrong with this instrument, sir," he said. "It is registering pressure equivalent to that at the Earth's surface."

I walked over and looked at the instrument. It certainly was registering the pressure that Norton had read, nor did there seem to be anything wrong with the instrument.

"There is a way to find out," I said. "We can shut down the insulating generator and open an air-cock momentarily." It was, of course, in some respects a risky pro-

ceeding, but with West at the generator, Jay at the air-cock and Norton at the pump I knew that we would be reasonably safe, even if there proved to be no atmosphere without. The only danger lay in the chance that we were hanging in a poisonous gas of the same density as the earthly atmosphere.

I tell you that it was a very tense moment as the three men took their posts to await my word of command. If it were atmosphere, we could propel the ship in it, and we could, if nothing more, go out on deck to breathe fresh air. It was arranged that at my word of command West was to shut off the generator, Jay to open the air-cock, and Norton to start the pump. If fresh air failed to enter through the tube Jay was to give the signal, whereupon Norton would reverse the pump, West start the generator, and immediately Jay would close the air-cock again.

Breathing the Lunar Air

AS JAY was the only man who was to take a greater chance than the others, I walked over and stood beside him, placing my nostrils as close to the air-cock as his. Then I gave the word of command. Everything worked perfectly and an instant later a rush of fresh, cold air was pouring into the hull of *The Barsoom*. West and Norton had been watching the effects upon our faces closely, so that they knew almost as soon as we did that the result of our test had been satisfactory.

I had them start the motors again then, and presently we were moving in a great spiral upward toward the interior of the Moon. Our progress was very slow, but as we rose the temperature rose slowly, too, while the barometer showed a very slightly decreasing atmospheric pressure. The luminosity, now above us, increased as we ascended, until finally the sides of the great well through which we were passing became slightly illuminated.

All this time Orthis had remained in irons in his stateroom. I had given instructions that he was to be furnished food and water, but no one was to speak to him, and I had taken Norton into my stateroom with me. Knowing Orthis to be a drunkard, a traitor and a potential murderer I had no sympathy whatsoever for him. I had determined to court-martial him and I knew that the verdict of any court, whether composed of the remaining crew of *The Barsoom* or appointed by the Judge Advocate General of the Navy, could result in but one thing, and that was death for Orthis.

About twenty-six hours after we entered the mouth of the crater at the surface of the Moon we suddenly emerged from its opposite end to look upon a scene that was marvelous and weird. A soft, diffused light revealed to us in turn mountains, valleys and sea, the details of which were more slowly encompassed by our minds. The mountains were as rugged as those upon the surface of the satellite, and appeared equally as lofty. They were, however, clothed with verdure almost to their summits, at least a few that were within our range of vision. And there were forests, too—strange forests, of strange trees, so unearthly in appearance as to suggest the weird phantasmagoria of a dream.

We did not rise much above five hundred feet from the opening of the well through which we had come from outer space when I described an excellent landing place and determined to descend. This was readily accomplished, and we made a safe landing close to a large forest and near the bank of a small stream. Then we opened the forward hatch and stepped out upon the deck of *The Barsoom*, the first Earth men to breathe the air of Luna. It was, according to Earth time, eleven a. m., January 8, 2026.

In the Heart of the Moon

I THINK that the first thing which engaged our interest and attention was the strange, and then, to us, unaccountable luminosity which pervaded the interior of the Moon. Above us were banks of fleecy clouds, the undersurfaces of which appeared to be lighted from beneath, while through breaks in the cloud banks we could discern a luminous firmament beyond, though nowhere was there any suggestion of a central incandescent orb radiating light and heat as does our sun. The clouds themselves cast no shadows upon the ground, nor, in fact, were there any well-defined shadows even directly beneath the hull of the ship or surrounding the forest trees which grew close at hand. The shadows

were vague and nebulous, blending off into nothingness at their edges. Yet the general illumination surrounding us approximated that of a very slightly hazy Earth day.

This peculiar lunar light interested us profoundly, but it was some time before we discovered the true explanation of its origin. It was of two kinds, emanating from widely different sources, the chief of which was due to the considerable radium content of the internal lunar soil, and principally of the rock forming the loftier mountain ranges, the radium being so combined as to diffuse a gentle perpetual light which pervaded the entire interior of the Moon. The secondary source was sunlight, which penetrated to the interior of the Moon through the hundreds of thousands of huge craters penetrating the lunar crust. It was this sunlight which caried heat to the inner world, maintaining a constant temperature of about eighty degrees Fahrenheit.

Centrifugal force in combination with the gravity of the Moon's crust, confined the internal lunar atmosphere to a blanket which we estimated at about fifty miles in thickness over the inner surface of this buried world. This atmosphere rarefies rapidly as one ascends the higher peaks, with the result that these are constantly covered with perpetual snow and ice, sending great glaciers down mighty gorges toward the central seas. The Earth seasons are reflected but slightly in the Moon, there being but a few degrees difference between summer and winter.

The natural circulation of the lunar atmosphere, affected as it is by the constantly-changing volume and direction of the sun's rays, as well as the great range of temperature between the valleys and the ice-clad mountain peaks, produces frequent storms of greater or less violence. High winds are accompanied by violent rains upon the lower levels and blinding snowstorms among the barren heights above the vegetation line. Rains which fell from low-hanging clouds are warm and pleasant; those which come from high clouds are cold and disagreeable, yet however violent or protracted the storm, the illumination remains practically constant—there are never any dark, lowering days within the Moon, nor is there any night.

Prismatic Vegetation

OF COURSE we did not reach all these conclusions in a few moments, but I have given them here merely as the outcome of our deductions following a considerable experience within the Moon. Several miles from the ship rose foothills which climbed picturesquely toward the cloudy heights of the loftier mountains behind them. There was no horizon, the distance that one could see being dependent solely upon one power of vision.

The ground about us was covered with rank vegetation of pale hues—lavenders, violets, pinks and yellows predominating. Pink grasses which became distinctly flesh-color at maturity grew in abundance, and the stalks of most of the flowering plants were of this same peculiar hue. The flowers themselves were often of highly complex form, of pale and delicate shades, of great size and rare beauty. There were low shrubs that bore a berry-like fruit, and many of the trees of the forest carried fruit of considerable size and of a variety of forms and colors. Norton and Jay were debating the possible edibility of some of these, but I gave orders that no one was to taste them until we had had an opportunity to learn by analysis or otherwise those varieties that were non-poisonous.

There was aboard *The Barsoom* a small laboratory equipped especially for the purpose of analyzing the vegetable and mineral products of Mars according to earthly standards, as well as other means of conducting research work upon our sister planet. I was anxious to ascertain the chemical properties of the water since the manufacture of this necessity was slow, laborious and expensive. I therefore instructed West to take a sample from the stream and subject it to laboratory tests, and the others I ordered below for sleep.

They were rather more keen to set out upon a tour of exploration, nor could I blame them, but as none of us had slept for rather better than forty-eight hours I considered it of importance that we recuperate our vital forces. Here were air, water and vegetation—the three prime requisites for the support of animal life—and so I judged it only reasonable to assume that animal life existed within the Moon. If it did exist, it might be in some highly pred-

atory form, against which it would tax our resources to the utmost to defend ourselves. I insisted, therefore, upon each of us obtaining his full quota of sleep before venturing from the safety of *The Barsoom*.

Flying Toads and Four-Legged Snakes

WE ALREADY had seen evidences of life of a low order, both reptile and insect, or perhaps it would be better to describe the latter as flying reptiles, as they later proved to be—toad-like creatures with the wings of bats, that flitted among the fleshy boughs of the forest, emitting plaintive cries. Upon the ground near the ship we had seen but a single creature, which had been plainly visible to us all and may be best described as a five-foot snake with four frog-like legs, and a flat head with a single eye in the center of the forehead. Its legs were very short, and as it moved along the ground it both wriggled like a true snake and scrambled with its four short legs. We watched it to the edge of the river and saw it dive in and disappear beneath the surface.

"Silly looking beggar," remarked Jay, "and devilish unearthly."

"I don't know about that," I returned. "He possessed nothing visible to us that we are not familiar with on Earth. Possibly he was assembled after a slightly different plan from any Earth creature; but aside from that he is familiar to us, even to his amphibious habits. And these flying toads, too; what of them? We have just as strange forms on Earth, though nothing precisely like these. Mars, too, has forms of animal and vegetable life peculiar to herself, yet nothing the existence of which would be impossible upon Earth, and she has, as well, human forms almost identical with our own. You see what I am trying to suggest?"

"Yes, sir," replied Jay; "that there may be human life similar to our own within the Moon."

"I see no reason to be surprised should we discover human beings here," I said; "nor would I be surprised to find a reasoning creature of some widely divergent form. I would be surprised, however, were we to find no form analogous to the human race of Earth."

"That is, a dominant race with well developed reasoning faculties?" asked Norton.

"Yes, and it is because of this possibility that we must have sleep and keep ourselves fit, since we may not know the disposition of these creatures, provided they exist, nor the reception that they will accord us. And so, Mr. Norton, if you will get a receptacle and fetch some water from the stream we will leave Mr. West on watch to make his analysis and the rest of us will turn in."

Norton went below and returned with a glass jar in which to carry the water and the balance of us lined the rail with our service revolvers ready in the event of an emergency as he went over the side. As Norton reached the bottom of the ladder and set foot on lunar soil I called to him to make haste. Just in front of him was a low bush and beyond it lay the river, about thirty feet distant. In response to my command he gave a slight leap to clear the bush and, to our amazement as well as his own consternation, rose fully eighteen feet into the air, cleared a space of fully thirty-five feet and lit in the river.

We Are Treated to a Ducking

"COME!" I said to the others, wishing them to follow me to Norton's aid, and sprang for the rail; but I was too impetuous. I never touched the rail, but cleared it by many feet, sailed over the intervening strip of land, and disappeared beneath the icy waters of the lunar river. I found myself in a sluggish, yet powerful current, the water seeming to move much as a heavy oil moves to the gravity of Earth. As I came to the surface I saw Norton swimming strongly for the bank and a second later Jay emerged not far from me. I glanced quickly around for West, whom I immediately perceived was still on the deck of *The Barsoom*, where, of course, it was his duty to remain, since it was his watch.

The moment that I realized that my companions were all safe I could not repress a smile, and then Norton and Jay commenced to laugh, and we were still laughing when we pulled ourselves from the stream a short distance below the ship.

"Get your sample, Norton?" I asked.

"I still have the container, sir," he replied, and indeed he had clung to it through-

out his surprising adventure, as Jay and I, fortunately, had clung to our revolvers. Norton removed the cap from the bottle and dipped the latter into the stream. Then he looked up at me and smiled.

"I think we have beaten Mr. West to it, sir," he said. "It seems like very good water, sir, and when I struck it I was surprised that I must have swallowed at least a quart."

"I tested a bit of it myself," I replied. "As far as we three are concerned, Mr. West's analysis will not interest us if he discovers that lunar water contains poisonous matter, but for his own protection we will let him proceed with his investigation."

"It is strange, sir," remarked Jay, "that none of us thought of the natural effects of the lesser gravity of the Moon. We have discussed the matter upon many occasions, as you will recall, yet when we faced the actual condition we gave it no consideration whatsoever."

"I am glad," remarked Norton, "that I did not attempt to jump the river—I should have been going yet. Probably landed on the top of some mountain."

As we approached the ship I saw West awaiting us with a most serious and dignified mien; but when he saw that we were all laughing he joined us, telling us after we reached the deck, that he had never witnessed a more surprising or ludicrous sight in his life.

Orthis Begs for Mercy

WE WENT below then and after closing and securing the hatch, three of us repaired to our bunks, while West with the sample of lunar water went to the laboratory. I was very tired and slept soundly for some ten hours, for it was the middle of Norton's watch before I awoke.

The only important entry upon the log since I had turned in was West's report of the results of his analysis of the water, which showed it was not only perfectly safe for drinking purposes but unusually pure, with an extremely low saline content.

I had been up about a half an hour when West came to me, saying that Orthis requested permission to speak to me. Twenty-four hours before, I had been fairly well determined to bring Orthis to trial and execute him immediately, but that had been when I had felt that we were all hopelessly doomed to death on his account. That he deserved death there was no question, but when men have faced death so closely and escaped, temporarily at least, I believe that they must look upon life as a most sacred thing and be less inclined to deny life to others. Be that as it may, the fact remains that having sent for Orthis in compliance with his request I received him in a mood of less stern and uncompromising justice that would have been the case twenty-four hours previous. When he had been brought to my stateroom and stood before me, I asked him what he wished to say to me. He was entirely sober now and bore himself with a certain dignity that was not untinged with humility.

"I do not know what has occurred since I was put in irons, as you have instructed the others not to speak to me or answer my questions. I have had ample time to reflect upon my actions. That I was intoxicated is, of course, no valid excuse, and yet it is the only excuse that I have to offer. I beg, sir, that you will accept the assurance of my sincere regret of the unforgivable things that I have done, and that you will permit me to live and atone for my wrongdoings, for if we are indeed upon the surface of the Moon it may be that we can ill spare a single member of our small party. I throw myself, sir, entirely upon your mercy, but beg that you will give me another chance."

Clemency for Orthis

REALIZING my natural antipathy for the man and wishing most sincerely not to be influenced against him because of it, I let his plea influence me against my better judgment with the result that I promised him that I would give the matter careful consideration, discuss it with the others, and be influenced largely by their decision. I had him returned to his stateroom then and sent for the other members of the party. With what fidelity my memory permitted I repeated to them in Orthis' own words his request for mercy.

"And now, gentlemen," I said, "I would like to have your opinions in the matter. I really wish to abide by your desires because of the personal antagonism that has existed

between Lieutenant Commander Orthis and myself since boyhood."

I knew that none of these men liked Orthis, yet I knew, too, that they would approach the matter in a spirit of justice tempered by mercy, and so I was not at all surprised when one after another assured me that they would be glad if I would give the man another opportunity.

Again I sent for Orthis, and after explaining to him that inasmuch as he had given his word to commit no disloyal act in the future, I should place him on parole, his eventual fate depending entirely upon his own conduct; then had his irons removed and told him that he was to return to duty. Would to God that instead of freeing him I had drawn my revolver and shot him through the heart!

We were all pretty well rested up by this time, and I undertook to do a little exploring in the vicinity of the ship, going out for a few hours each day with a single companion, leaving the other three upon the ship. I never went far afield at first, confining myself to an area some five miles in diameter between the crater and the river. Upon both sides of the latter, below where the ship had landed, was a considerable extent of forest. I ventured into this upon several occasions and once, just about time for us to return to the ship, I came upon a well marked trail in the dust of which were the imprints of three-toed feet. Each day I set the extreme limit of time that I would absent myself from the ship with instructions that two of those remaining aboard should set out in search of me and my companion, should we be absent over the specified number of hours. Therefore, I was unable to follow the trail the day upon which I discovered it, since we had scarcely more than enough time to make a brief examination of the tracks if we were to reach the ship within the limit I had allowed.

We Follow a Mysterious Spoor

IT CHANCED that Norton was with me that day and in his quiet way was much excited by our discovery. We were both positive that the tracks had been made by a four-footed animal, something that weighed between two hundred fifty and three hundred pounds. How recently it had been used we could scarcely estimate, but the trail itself gave every indication of being a very old one. I was sorry that we had no time to pursue the animal which had made the tracks but determined that upon the following day I should do so. We reached the ship and told the others what we had discovered.

After Orthis had been released from arrest Norton had asked permission to return to the former's stateroom. I had granted his request and the two had been very much together ever since. I could not understand Norton's apparent friendship for this man, and it almost made me doubt the young ensign. One day I was to learn the secret of this intimacy, but at the time I must confess that it puzzled me considerably and bothered me not a little.

Each of the men had now accompanied me on my short excursions of exploration with the exception of Orthis. Inasmuch as his parole had fully reinstated him among us, in theory at least, I could not very well discriminate against him.

The day following our discovery of the trail, I accordingly invited him to accompany me, and we set out early, each armed with a revolver and a rifle. I advised West, who automatically took command of the ship during my absence, that we might be gone considerably longer than usual and that he was to feel no apprehension and send out no relief party unless we should be gone a full twenty-four hours, as I wished to follow up the spoor we had discovered.

I led the way directly to the spot at which we had found the trail, about four miles down the river from the ship and apparently in the heart of dense forest.

The flying-toads darted from tree to tree about us, uttering their weird and plaintive cries, while upon several occasions, as in the past, we saw four-legged snakes such as we had seen upon the day of our landing. Neither the toads nor the snakes bothered us, seeming only to wish to avoid us.

Beasts or Human Beings?

JUST before we came upon the trail, both Orthis and I thought we heard the sound of footsteps ahead of us—something similar to that made by a galloping animal—and when we came upon the trail a

moment later it was apparent to both of us that dust was hanging in the air and slowly settling on the vegetation nearby. Something, therefore, had passed over the trail but a minute or two before we arrived. A brief examination of the spoor revealed the fact that it had been made by a three-toed animal whose direction of travel was to our right and toward the river, at this point some half mile from us.

I could not help but feel considerable inward excitement, and I was sorry that one of the others had not been with me, for I never felt perfectly at ease with Orthis. I had done considerable hunting in various parts of the world where wild game still exists but I had never experienced such a thrill as I did at the moment that I undertook to stalk this unknown beast upon an unknown trail in an unknown world.

The trail led to the edge of the river which at this point was very wide and shallow. Upon the opposite shore, I could see the trail again directly opposite and I knew therefore that this was a ford. Without hesitating, I stepped into the river, and as I did so I glanced to my left to see stretching before me as far as my eye could reach a vast expanse of water. Here then I had stumbled upon the mouth of the river and, beyond, a lunar sea.

The land upon the opposite side of the river was rolling and grass-covered, but in so far as I could see, almost treeless. As I turned my eyes from the sea back toward the opposite shore, I saw that which caused me to halt in my tracks, cock my rifle and issue a cautious warning to Orthis for silence, for there before us upon a knoll stood a small horse-like animal.

It would have been a long shot, possibly five hundred yards, and I should have preferred to have come closer but there was no chance to do that now, for we were in the middle of the river in plain view of the animal which stood there watching us intently. I had scarcely raised my rifle, however, ere it wheeled and disappeared over the edge of the knoll upon which it had been standing.

"What did it look like to you, Orthis?" I asked my companion.

"It was a good ways off," he replied, "and I only just got my binoculars on it as it disappeared. It was about the size of a small pony, I should say, but it didn't have a pony's head."

"It appeared tailless to me?" I remarked.

"I saw no tail," said Orthis, "nor any ears or horns. It was a devilish funny looking thing. I don't understand it. There was something about it—" he paused. "My God, sir, there was something about it that looked human."

"It gave me that same impression, too, Orthis, and I doubt if I should have fired had I been able to cover it, for just at the instant that I threw my rifle to my shoulder I felt that same strange impression that you mention. There was something human about the thing."

Surprised by the Horse-Humans

AS WE talked, we had been moving on across the ford. Finally, we stepped out on the opposite shore and a moment later, far to the left, we caught another glimpse of the creature that we had previously seen. It stood upon a distant knoll, evidently watching us.

Orthis and I raised our binoculars to our eyes almost simultaneously and for a full minute we examined the thing as it stood there, neither of us speaking, and then we dropped our glasses and looked at each other.

"What do you make of it, sir?" he asked.

I shook my head. "I don't know what to make of it, Orthis," I replied; "but I should swear that I was looking straight into a human face, and yet the body was that of a quadruped."

"There can be no doubt of it, sir," he replied, "and this time one could see the harness and the clothing quite plainly. It appears to have some sort of a weapon hanging at its left side. Did you notice it, sir?"

"Yes, I noticed it, but I don't understand it."

A moment longer we stood watching the creature until it turned and galloped off, disappearing behind the knoll on which it had stood. We decided to follow the trail. We had gone but a short distance when the trail approached the river again, which puzzled me at the time somewhat, as we had gone apparently directly away from the river since we had left the ford, but after we had gone some mile and a half, we

found the explanation, since we came again to another ford while on beyond we saw the river emptying into the sea and realized that we had crossed an island lying in the mouth of the river.

I was hesitating as to whether to make the crossing and continue along the trail or to go back and search the island for the strange creature we had discovered. I rather hoped to capture it. As I stood there, rather undecided, our attention was attracted back to the island by a slight noise, and as we looked in the direction of the disturbance, we saw five of the creatures eyeing us from high land a quarter of a mile away. When they saw that they were discovered they galloped boldly toward us. They had come a short distance only, when they stopped again upon high knoll, and then one of them raised his face toward the sky and emitted a series of piercing howls. Then they came on again toward us nor did they pause until they were within fifty feet of us, when they came to a sudden halt.

The Men in the Moon

OUR first view of the creatures proved beyond a question of a doubt that they were in effect human quadrupeds. The faces were very broad, much broader than any human faces that I have ever seen, but their profiles were singularly like those of the ancient North American Indians. Their bodies were covered with a garment with short legs that ended above the knees. About the barrel of each was a surcingle and connected with it by a backstrap was something analogous to a breeching in Earth horse harness.

Straps running on the left side supported a sheath in which was carried what appeared to be a knife of some description. And upon the right side a short spear was carried in a boot, similarly suspended from the two ornaments, much as the carbine of our ancient Earth cavalry was carried. The spear, which was about six feet long, was of peculiar design, having a slender, well-shaped head, from the base of which a crescent-shaped arm curved backward from one side, while upon the side opposite the crescent was a short, sharp point at right angles to the median line of the weapon.

For a moment we stood there eyeing each other, and from their appearance I judged that they were as much interested in us as we were in them. I noticed that they kept looking beyond us, across the river toward the mainland. Presently, I turned for a glance in the same direction, and far away beyond a thin forest I saw a cloud of dust which seemed to be moving rapidly toward us. I called Orthis' attention to it.

"Reinforcements," I said. "That is what that fellow was calling for when he screamed. I think we had better try conclusions with the five before any more arrive. We will try to make friends first, but if we are unsuccessful we must fight our way back toward the ship at once."

Accordingly, I stepped forward toward the five with a smile upon my lips and my hand outstretched. I knew of no other way in which to carry to them an assurance of our friendliness. At the same time, I spoke a few words in English in a pleasant and conciliatory tone. Although I knew that my words would be meaningless to them, I hoped that they would catch their intent from my inflection.

Attacked!

IMMEDIATELY upon my advance, one of the creatures turned and spoke to another, indicating to us for the first time that they possessed a spoken language. Then he turned and addressed me in a tongue that was, of course, utterly meaningless to me; but if he had misinterpreted my action, I could not misunderstand that which accompanied his words, for he reared up on his hind feet and simultaneously drew his spear and a wicked-looking, short-bladed sword or dagger, his companions at the same time following his example, until I found myself confronted by an array of weapons backed by scowling, malignant faces. Their leader uttered a single word which I interpreted as meaning halt, and so I halted.

I pointed to Orthis and to myself, and then to the trail along which we had come, and then back in the direction of the ship. I was attempting to tell them that we wished to go back whence we had come. Then I turned to Orthis.

"Draw your revolver," I said, "and follow me. If they interfere we shall have to

"Flesh, flesh! We are hungry! Give us flesh!"

shoot them. We must get out of this before others arrive."

As we turned to retrace our steps along the trail, the five dropped upon all fours, still holding their weapons in their fore-paws, and galloped quickly to a position blocking our way.

"Stand aside," I yelled, and fired my pistol above their heads. From their actions, I judged that they had never before heard the report of a firearm, for they stood an instant in evident surprise, and then wheeled and galloped off for about a hundred yards, where they turned and halted again, facing us. They were still directly across our trail, and Orthis and I moved forward determinedly toward them.

When we had arrived at a few yards from them, I again threatened them with my pistol, but they stood their ground, evidently reassured by the fact that the thing that I held in my hand, though it made a loud noise, inflicted no injury. I did not want to shoot one of them if I could possibly avoid it, so I kept on toward them.

I was within a few feet of them now, and their attitude was more war-like than ever,

convincing me that they had no intention of permitting us to pass peacefully.

Their features, which I could now see distinctly, were hard, fierce, and cruel in the extreme. Their leader seemed to be addressing me, but, of course, I could not understand him; but when, at last, standing there upon his hind feet, with evidently as much ease as I stood upon my two legs, he carried his spear back in a particularly menacing movement, I realized that I must act and act quickly.

We Destroy the Moon Creatures

I THINK the fellow was just on the point of launching his spear at me, when I fired. The bullet struck him square between the eyes and he dropped like a log, without a sound. Instantly, the others wheeled again and galloped away, this time evincing speed that was almost appalling, clearing spaces of a hundred feet in a single bound.

A glance behind me showed the dust-cloud rapidly approaching the river, upon the mainland, and calling to Orthis to follow me, I ran rapidly along the trail which led back in the direction of the ship.

The four Moon creatures retreated for about half a mile, and then halted and faced us. We were nearing them rapidly, for we had discovered that we, too, could show remarkable speed, when retarded by gravity only one-sixth of that of Earth. To clear forty feet at a jump was nothing. As we neared the four, who had taken their stand upon the summit of a knoll, I heard a great splashing in the river behind us, and turning, saw that their reinforcements were crossing the ford, and would soon be upon us. There appeared to be fully a hundred of them, and our case looked hopeless indeed, unless we could manage to pass the four ahead of us, and reach the comparative safety of the forest beyond the first ford.

"Commence firing, Orthis," I said. "Shoot to kill. Take the two at the left as your targets, and I'll fire at the two at the right. We had better halt and take careful aim, as we cannot afford to waste ammunition."

We came to a stop about twenty-five yards from the foremost creature, which is a long pistol shot; but they were standing still upon the crest of a knoll, distinctly outlined against the sky, and were such a size as to present a most excellent target. Our shots rang out simultaneously. The creature at the left, at which Orthis had aimed, leaped into the air, and fell to the ground, where it lay kicking convulsively. The one to the right uttered a piercing shriek, clutched at its breast, and dropped dead. Then Orthis and I charged the remaining two, while behind us we heard loud weird cries and the pounding of galloping feet. The two before us did not retreat this time, but came to meet us, and again we halted and fired. This time they were so close that we could not miss them, and the last of our original lunar foemen lay dead before us.

Beset by Reinforcements

WE RAN then, ran as neither of us had imagined human beings ever could run. I know that I covered over fifty feet in many a leap, but by comparison with the speed of the things behind us, we might have been standing still. They fairly flew over the lavender sward. I venture to say that some of them leaped fully three hundred feet at a time, and now, at every bound, they emitted fierce and terrible yells.

"It's no use, Orthis," I said to my companion. "We might as well make our stand here and fight it out. We cannot reach the ford. They are too fast for us."

We stopped then, and faced them, and when they saw we were going to make a stand, they circled and halted about a hundred yards distant, entirely surrounding us. We had killed five of their fellows, and I knew we could hope for no quarter. I knew that if we ever escaped that fierce cordon, it would be by fighting our way through it.

"Come," I said to Orthis, "straight through for the ford," and turning again in that direction, I started blazing away with my pistol as I walked slowly along the trail. Orthis was at my side, and he, too, fired as rapidly as I. Each time our weapons spoke, a Moon Man fell. And now, they commenced to circle us at a run. They hurled spears at us, but I think the sound of our revolvers and the effect of the shots had to some measure unnerved them,

for their aim was poor and we were not, at any time, seriously menaced.

As we advanced slowly, firing, we made many hits, but I was horrified to see that every time one of the creatures fell, the nearest of his companions leaped upon him and cut his throat from ear to ear. One of them had only to fall to be dispatched by his fellows. A bullet from Orthis' weapon shattered the hind leg of one of them, bringing him to the ground. It was, of course, not a fatal wound, but the creature had scarcely gone down, when the nearest to him sprang forward, and finished him. And thus we walked slowly toward the ford, and I commenced to have hope that we might reach it and make our escape. If our antagonists had been less fearless, I should have been certain of it, but they seemed almost indifferent to their danger, evidently counting upon their speed to give them immunity from our bullets.

Captured!

WE WERE almost at the ford when the circle suddenly broke, and then formed a straight line parallel to us, the leader swinging his spear about his head, grasping the handle at its extreme end. The weapon moved at great speed, in an almost horizontal plane. I was wondering at the purpose of his action, when I saw that three or four of those directly in the rear of him had commenced to swing their spears in a similar manner. There was something strangely menacing about it that filled me with alarm. I fired at the leader and missed, and at the report of my pistol, a half dozen of them let go of their swift whirling spears, and an instant later, I realized the purpose of their strange maneuver. The heavy weapons shot toward us, butts first, with the speed of lightning, the crescent-like hooks catching us around a leg, an arm and the neck, hurling us backward to the ground, and each time we essayed to rise, we were struck again, until we finally lay there, bruised and half stunned, and wholly at the mercy of our antagonists, who galloped forward quickly, stripping our weapons from us. Those who had hurled their spears at us recovered them, and then they all gathered about, examining us, and jabbering among themselves.

Presently, the leader spoke to me, prodding me with the sharp point of his spear. I took it that he wanted me to arise, and I tried to do so, but I was pretty much all in and fell back each time I essayed to obey. Then he spoke to two of his followers, who lifted me and laid me across the back of a third. There I was fastened in a most uncomfortable position by means of leather straps which were taken from various parts of the harnesses of several of the creatures. Orthis was similarly lashed to another of them, whereupon they moved slowly back in the direction from which they had come, stopping, as they went, to collect the bodies of their dead, which were strapped to the backs of others of their companions.

As we crossed the ford toward the mainland, it was with difficulty that I kept from being drowned, since my head dragged in the water for a considerable distance and I was mighty glad when we came out again on shore. The thing that bore me was apparently quite tireless, as were the others, and we often moved for what seemed many miles at a fast run. Of course, my lunar weight was equivalent to only about thirty pounds on Earth while our captors seemed fully as well-muscled as a small earthly horse.

In the Camp of the Moon Men

HOW long we were on the march, I do not know, for where it is always daylight and there is no sun nor other means of measuring time, one may only guess at its duration, the result being influenced considerably by one's mental and physical sensations during the period. Judged by these considerations, then, we might have been on the trail for many hours, for I was not only most uncomfortable in body, but in mind as well. However that may be, I know only that it was a terrible journey; that we crossed rivers twice after reaching the mainland, and came at last to our destination, amid low hills, where there was a level, parklike space, dotted with weird trees. Here the straps were loosened, and we were dumped upon the ground, more dead than alive.

When I was finally able to sit up and look about, I saw that we were at the threshold of a camp or village, consisting of a

number of rectangular huts, with high-peaked roofs, thatched or rather shingled, with the broad, round leaves of the trees that grew about.

We saw now for the first time the females and the young. The former were similar to the males, except that they were of lighter build, and they were far more numerous. They had udders, with from four to six teats, and many of them were followed by numerous progeny, several that I saw having as high as six young in a litter. From the way the women and children rushed upon us as we were unloaded in camp, I felt that they were going to tear us to pieces, and I really believe they would have had not our captors prevented.

Evidently the word was passed that we were not to be injured, for after the first rush they contented themselves with examining us, and sometimes feeling of us or our clothing, the while they discussed us, but with the bodies of those who were slain, it was different, for when they discovered these had been unloaded upon the ground, they fell upon them and commenced to devour them, the warriors joining them in the gruesome and terrible feast. Orthis and I understood now that they had cut the throats of their fellows to let the blood, in anticipation of the repast to come.

Survival of the Fittest

AS WE came to understand them and the conditions under which they lived, many things concerning them were explained. They are naturally carnivorous, but with the exception of one other creature upon which they prey, there is no animal in that part of the interior lunar world with which I am familiar, that they may eat with safety. The flying-toad and the walking snake and the other reptilia are poisonous, and they dare not eat them.

The time had been, I later learned, possibly, however, ages before, when many other animals roamed the surface of the inner Moon, but all had become extinct except our captors and another creature, of which we, at the time of our capture, knew nothing, and these two preyed upon one another, while the species which was represented by those into whose hands we had fallen, raided the tribes and villages of their own kind for food, and ate their own dead, as we had already seen. As it was the females to whom they must look for the production of animal food, they did not kill these of their own species and never ate the body of one. Enemy women of their own kind, whom they captured, they brought to their villages, each warrior adding to his herd the individuals that he captured. As only the males are warriors, and as no one will eat the flesh of the female, the mortality among the males is, accordingly, extremely high, accounting for the vastly greater number of adult females. The latter are very well treated, as the position of a male in a community is dependent largely upon the size of his herd.

The principal mortality among the females results from three causes—raids by the other flesh-eating species which inhabit the inner lunar world, quarrels arising from jealousy among themselves, and death while bringing forth their young.

These creatures eat fruit and herbs and nuts as well as meat, but they do not thrive well upon these things exclusively. Their existence, therefore, is dependent upon the valor and ferocity of their males whose lives are spent in making raids and forays against neighboring tribes and in defending their own villages against invaders.

As Orthis and I sat watching the disgusting orgy of cannibalism about us, the leader of the party that had captured us came toward us from the center of the village, and speaking a single word, which I later learned meant come, he prodded us with his spear point until we staggered to our feet. Repeating the word, then, he started back into the village.

"I guess he wants us to follow him, Orthis," I said. And so we fell in behind the creature, and stepped on in the direction that he had taken, which led toward a very large hut—by far the largest in the village.

Examined by the Va-gas

IN THE side of the hut presented to us there seemed to be but a single opening, a large door covered by a heavy hanging, which our conductor thrust aside as we entered the interior with him. We found ourselves in a large room, without any other opening whatsoever, save the doorway through which we had entered, and over

which the hanging had again been drawn, yet the interior was quite light, though not so much so as outside, but there were no means for artificial lighting apparent. The walls were covered with weapons and with the skulls and other bones of creatures similar to our captors.

Lying upon a bed of grasses at the opposite side of the room was a large male whose skin was so much deeper lavender hue than the others that we had seen, as to almost suggest a purple. The face, though badly disfigured by scars, and grim and ferocious in the extreme, was an intelligent one, and the instant that I looked into those eyes, I knew that we were in the presence of a leader.

A few words passed between the two, and then the chief arose and came toward us. He examined us very critically, our clothing seeming to interest him tremendously. He tried to talk with us, evidently asking us questions, and seemed very much disgusted when it became apparent to him that we could not understand him.

He gave some instructions to the fellow who had brought us, and we were taken out again, and to another hut, to which there was presently brought a portion of the carcass of one of the creatures we had killed before we were captured. I could not eat any of it, however, and neither could Orthis; and after a while, by signs and gestures, we made them understand that we wished some other kind of food, with the result that a little later, they brought us fruit and vegetables, which were more palatable and, as we were to discover later, sufficiently nutritious to carry us along and maintain our strength.

I had become thirsty, and by simulating drinking, I finally succeeded in making plain to them my desire in that direction, with the result that they led us out to a little stream which ran through the village, and there we quenched our thirst.

We Learn the Lunar Language

SHORTLY after we arrived at the village, they took away our watches, our pocket-knives, and everything that we possessed of a similar nature, and which they considered as curiosities. The chief wore Orthis' wristwatch above one fore-paw and mine above the other, but as he did not know how to wind them, nor the purpose for which they were intended, they did him or us no good. The result was, however, that it was now entirely impossible for us to measure time in any way, and I do not know, even to this day, how long we were in this strange village. We ate when we were hungry, and slept when we were tired.

It must have been immediately after we arrived that they made an attempt to teach us their language. Two females were detailed for this duty. We were given unlimited freedom within certain bounds, which were well indicated by the several sentries which constantly watched from the summit of hills surrounding the village. Past these we could not go, nor do I know that we had any particular desire to do so, since we realized only too well that there would be little chance of our regaining the ship should we escape the village, inasmuch as we had not the remotest idea in what direction it lay.

Our one hope lay in learning their language, and then utilizing our knowledge in acquiring some definite information as to the surrounding country and the location of *The Barsoom*.

It did not seem to take us very long to learn their tongue, though, of course, I realize that it may really have been months. Almost before we knew it, we were conversing freely with our captors.

It is a very difficult language to speak, and as a written language, would be practically impossible. For example, there is their word gu-e-ho, for which Orthis and I discovered twenty-seven separate and distinct meanings, and that there are others I have little or no doubt. The speech is more aptly described as song, the meaning of each syllable being governed by the note in which it is sung.

Fortunately for us, there are no words of over three syllables, and most of them consist of only one or two, or we should have been entirely lost. The resulting speech, however, is extremely beautiful, and Orthis used to say that if he closed his eyes, he could imagine himself living constantly in grand opera.

I Talk With Ga-va-go

THE chief's name, as we learned, was Ga-va-go; the name of the tribe or village was No-vans, while the race to which they belonged was known as Va-gas.

When I felt that I had mastered the language sufficiently well to make myself at least partially understood, I asked to speak to Ga-va-go, and shortly thereafter, I was taken to him.

"You have learned our speech?" he asked.

I nodded in the affirmative. "I have," I said, "and I have come to ask why we are held captives. We wish only to be friends, and to be allowed to go our way in peace."

"What manner of creature are you," he asked, "and where do you come from?"

I asked him if he had ever heard of the Sun and the stars or any worlds outside his own, and he had replied that he had not, and that there were no such things.

"But there are, Ga-va-go," I said, "and I and my companion are from another world, far, far outside your own. An accident brought us here. Give us back our weapons, and let us go."

He shook his head negatively.

"Where you come from, do you eat one another?" he asked.

"No," I replied, "we do not."

"Why?" he asked, and I saw his eyes narrow as he awaited my reply.

Was it mental telepathy or just luck that put the right answer in my mouth, for somehow, intuitively, I seemed to grasp what was in the creature's mind.

"Our flesh is poison," I said, "those who eat it die."

He looked at me then for a long time, with an expression upon his face which I could not interpret. Presently he asked me another question.

"Are there many like you in the land where you live?"

"Millions upon millions," I replied.

"And what do they eat?"

"They eat fruits and vegetables and the flesh of animals," I answered.

"What animals?" he asked.

"I have seen no animals here like them," I replied, "but there are many kinds unlike us, so that we do not have to eat flesh of our own race."

"Where is your country?" he demanded. "Take me to it."

I smiled. "I cannot take you to it," I said. "It is upon another world."

It was quite evident that he did not believe me, for he scowled at me ferociously.

"Do you wish to die?" he demanded.

I told him that I had no such longing.

"Then you will lead me to your country," he said, "where there is plenty of flesh for everyone. You may think about it until I send for you again. Go!" And thus he dismissed me. Then he sent for Orthis, but what Orthis told him, I never knew exactly. I had occasion to notice, however, that from that time Ga-va-go indicated a marked preference for Orthis, and the latter was often called to his hut.

The Va-gas Break Camp

I WAS momentarily expecting to be summoned in to Ga-va-go's presence, and learn my fate, when he discovered that I could not lead him to my country, where flesh was so plentiful. But at about this time we broke camp, and in the press of other matters, he evidently neglected to take any further immediate action in my case, or at least, so I thought, until I later had reason to suspect that he felt that he need no longer depend upon me to lead him to this land of milk and honey.

The Va-gas are a nomadic race. The move that we made now was necessitated by the fact that all the other tribes nearby had fled before the ferocity of the No-vans, whose repeated and successful raids had depleted the villages of their neighbors and filled them with terror.

The breaking of camp was a wonderfully simple operation. All their few belongings, consisting of extra clothing, trappings, weapons, and their treasured skulls and bones of victims, were strapped to the backs of the women. Orthis and I each bestrode a warrior detailed by Ga-va-go for the purpose of transporting us, and we filed out of the village, leaving the huts behind.

Because of the women and the children, we moved more slowly than warriors do when on the march alone, when they seldom, if ever, travel slower than a trot, and more generally, at a fast gallop. We moved along a well-worn trail, passing several deserted villages, from which the prey of the

No-vans had fled. We crossed many rivers, for the lunar world is well watered. We skirted several lakes, and at one point of high ground, I saw, far at our left, the waters of what appeared to be a great ocean.

There was never a time when Orthis and I were not plentifully supplied with food, for there is an abundance of it growing throughout all the territory we crossed, but the No-vans had been without flesh for several days and were, in consequence, mad with hunger, as the fruits and vegetables which they ate seemed not to satisfy them at all.

The Wrath of Zo-al

WE WERE moving along at a brisk trot when, without warning, we were struck by a sudden gust of wind that swept, cold and refreshing, down from some icy mountain fastness. The effect upon the No-vans was electrical. I would not have had to understand their language to realize that they were terrified.

A moment later a dash of rain struck us, and then it was every man for himself and the devil take the hindmost, as they broke into a wild stampede to place themselves close to their chief. Their hysterical flight was like the terrorized rush of wild cattle.

Old Ga-va-go, who was in the lead, had stopped and was waiting for us. Those who accompanied him seemed equally terrified with the rest, but evidently they did not dare run until Ga-va-go gave the word. Ga-va-go waited until the last of the rear-guard straggled in, and then he set off directly toward the mountains, the entire tribe moving in a compact mass, though they might have fallen easy prey to an ambush or any sudden attack. They knew, however, what I half guessed, that knowing that their enemies were as terrified of the storms as they, there was little danger of their being attacked.

We came at last to a hillside covered with great trees which offered some protection from both the wind and the rain, which had now arisen to the proportion of a hurricane.

As we came to a halt, I slipped from the back of the warrior who had been carrying me, and found myself beside one of the women who had taught Orthis and me the language of the Va-gas.

"Why is everyone so terrified?" I asked her.

"It is Zo-al," she whispered, fearfully. "He is angry."

"Who is Zo-al?" I asked.

She looked at me in wide-eyed astonishment. "Who is Zo-al!" she repeated. "They told me that you said that you came from another world, and I can well believe it, when you ask, who is Zo-al?"

"Well, who is he?" I insisted.

"He is a great beast," she whispered. "He is everywhere. He lives in all the great holes in the ground, and when he is angry, he comes forth and makes the water fall and the air run away. We know that there is no water up there," and she pointed toward the sky. "But when Zo-al is angry, he makes water fall from where there is no water, so mighty is Zo-al, and he makes the air to run away so that the trees fall before it as it rushes past, and huts are knocked flat or carried high above the ground. We have angered Zo-al, and he is punishing us."

The Light That Devours

IT WAS at that instant that there broke upon my ears the most terrific detonation that I have ever heard. So terrific was it that I thought my ear drums had burst, and simultaneously, a great ball of fire seemed to come rolling down from the mountain heights above us.

The woman, covering her ears, shuddered, and when she saw the ball of fire, she voiced a piercing shriek.

"The light that devours!" she cried. "When that comes too, it is the end, for then is Zo-al mad with rage."

The ground shook to the terrifying noise, and though the ball of fire did not pass close to us, still could I feel the heat of it even as it went by at a distance, leaving a trail of blackened and smoking vegetation in its rear. It must have traveled about ten miles, down toward the sea, across rolling hills and level valleys, when suddenly it burst, the explosion being followed by a report infinitely louder than that which I had first heard.

I had witnessed my first lunar electrical storm, and I did not wonder that the inhabitants of this strange world were terrified by it. As we cowered there among the

trees, I wondered if they were not afraid that the wind would blow the forest down and crush them, and I asked the woman who stood beside me.

"Yes," she said, "that often happens, but more often does it happen that if one is caught in a clearing, the air that runs away picks him up and carries him along to drop him from a great height upon the hard ground. The trees bend before they break, and those who watch are warned."

"It seems to me," I said, "that it would have been safer if Ga-va-go had led us into one of those sheltered ravines," and I indicated a gorge in the hillside at our right.

"No," she said, "Ga-va-go is wise. He led us to the safest spot. We are sheltered from the air that runs away, and perhaps a little from the light that devours, nor can the waters that drown, reach us here, for presently they will fill that ravine full."

Nor was she wrong. Rushing down from the hillside, the water poured in torrents into the ravine, and presently, though it must have been twenty or thirty feet deep, it was filled almost to overflowing. Whoever had sought refuge there, would have been drowned and washed away to the big ocean far below.

The Storm Terror

THE storm must have lasted for a considerable time; how long, of course, I do not know. During the entire storm, the No-vans scarcely moved from their positions beneath the trees, with their backs toward the storm, where they stood with lowered heads like cattle. We experienced twelve detonations of the ground-shaking thunder, and witnessed six manifestations of the light that devours. Trees had fallen all about us, and as far as we could see, the grasses lay flat and matted upon the ground.

They told me that storms of the severity of this were infrequent, though rain and wind, accompanied by electrical manifestations, might be expected at any season of the year—I use that expression from habit, for one can scarcely say that there are any well-marked seasonal changes within the Moon that could indicate corresponding divisions of time as upon the Earth. A period of drought and cold rains retard growth and germination, while frequent water rains have an opposite effect, the result being that you find vegetation of the same variety in all stages of development, growing side by side—blossoms upon one tree, fruit upon another, and the dry seed-pods upon a third. Not even, therefore, by the growth of plant life, might one measure time within the Moon, and the period of gestation among the Va-gas is similarly irregular, being affected by the physical condition of the female as well as by climatic conditions, I imagine. When the tribe is well-fed, and the weather warm, the warriors victorious, and the minds of the women at peace, they bring forth their young in an incredibly short period.

On the other hand, a period of cold, or of hunger, and of long marches, following defeat, induces an opposite result. The females nurse their young for a very short period of time, for they grow rapidly, and as soon as their molars are through, and they can commence eating meat, they are weaned. They are devilish little rascals, their youthful exuberance finding its outlet in acts of fiendish cruelty. As they are not strong enough to inflict their tortures on adults they penetrate them upon one another, with the result that the weaker are often killed.

During the storm, they huddled, shivering and cold, against the adults. Possibly I should be ashamed to say it, but I felt no pity for them, and rather prayed that they would all be chilled to death, so hateful and wantonly cruel were they. As they become adults, they are less wanton in their atrocities, though no less cruel, their energies, however, being intelligently directed upon the two vital interests of their lives—procuring flesh and women.

The Coming of the U-ga

SHORTLY after the rain ceased, the wind began to abate, and as I was cold, cramped and uncomfortable, I walked out into the open. As I walked briskly to and fro, looking here and there at the evidences of the recent storm, my glance chanced to rise toward the sky, and there I saw what appeared at first to be a huge bird, a few hundred feet above the forest in which we had sought shelter. It was flapping its great wings weakly and seemed to be almost upon the verge of exhaustion, and though I

could see that it was attempting to fly back in the direction of the mountains, the force of the wind was steadily carrying it in the direction of the lowlands and the sea. Presently it would be directly above me, and as it drew nearer, I knit my brows in puzzlement, for except for its wings, and what appeared to be a large hump upon its back, its form bore a striking resemblance of that of a human being.

Some of the No-vans evidently saw me looking upwards thus interestedly, and prompted by curiosity, joined me. When they saw the creature flying weakly overhead, they set up a great noise, until presently all the tribe had run into the open and were looking up at the thing above us.

The wind was lessening rapidly, but it still was strong enough to carry the creature gently toward us, and at the same time I perceived that whatever it was, it was falling slowly to the ground, or more correctly, sinking slowly.

"What is it?" I asked of the warrior standing beside me.

"It is a U-ga," he replied. "Now shall we eat."

I had seen no birds in the lunar world, and as I knew they would not eat the flying reptiles, I guessed that this must be some species of bird life, but as it dropped closer, I became more and more convinced that it was a winged human being, or at least a winged creature with human form.

As it fluttered toward the ground, the No-vans run along to meet it, waiting for it to fall within reach. As they did so, Ga-va-go called to them to bring the creature to him alive and unharmed.

I was about a hundred yards from the spot, when the poor thing finally fell into their clutches. They dragged it to the ground roughly, and a moment later I was horrified to see them tear its wings from it and the hump from its back. There was a great deal of grumbling at Ga-va-go's order, as following the storm and their long fast, the tribe was ravenously hungry.

"Flesh, flesh," they growled. "We are hungry. Give us flesh!" But Ga-va-go paid no attention to them, standing to one side beneath a tree, awaiting the prisoner that they were bringing toward him.

Into the Dreaded Moon Crater

THE strange wing-bearing creature who has fallen into the hands of the No-vans proves to be Nah-ee-lah the Moon Maid, most beautiful of all the women of Laythe. In the next installment of this gripping story Julian rescues the Moon Maid from the clutches of the treacherous Orthis and escapes with her from the custody of the No-vans, only to confront danger in hideous form in the heart of the Moon Crater. Don't fail to continue this story in the

December *Modern Mechanics* Magazine

Science of Golf

What makes the championship golfer? The movies show you here every motion that goes into the perfect mashie shot, as executed by the noted Tommy Armour.

HOW closely science assists in furthering the delights of our national pastimes is well illustrated in the way motion pictures are teaching the fine points of golf shots.

The camera catches and holds each movement, thus allowing the beginner an opportunity to study the actual shot in full detail. Every motion of the finished golfer is a lesson in itself, but it would be impossible to demonstrate these points in action without the movies.

On the opposite page appears a series of motion pictures showing the famous Tommy Armour, former American open champion, making a mashie shot. Follow the pictures from left to right, letting the eyes glide swiftly back and forth across the page. Then turn your attention to the story told by each picture.

Armour is particularly noted for his deadly accuracy with the niblick and mashie clubs. These pictures show why. In each of the series the compact, closely controlled arm action is easily seen by the dominant factor in making the mashie shot.

In the first picture note the overlapping grip, which is notable for the fact that the hands are well on top of the shaft—with the right hand well over toward the left and the left well over toward the right, giving him great power in the fingers for handling the club.

In the succeeding pictures see how closely in to the side Armour keeps his right arm at the top of the backswing, and how straight the left arm is held until well after impact. Observe, too, how far the body and legs have turned back toward the position in the address, although the clubhead has not traveled more than three feet on the way down. The right side is put into the shot, the body following smoothly and easily around with the swing. There is no sign of tenseness or jerky effort.

The student will also perceive that the head is held stationary, and there is no body sway in performing the shot. Another interesting point can be taken by noting closely the retreating feet showing just above Tommy Armour's head in these pictures. The lifted right feet have been set down in the time it takes Armour to start his backswing, and the left feet are picked up and set down by the time he is coming down for the stroke. This gives you the proper timing for the shot. Study the snapshots for other pointers.

Armour in Action

TOMMY ARMOUR declared at the close of the American open golf tournament at Oakmont last year that his niblick and mashie won the championship for him. Time after time he placed full mashie shots dead to the pin for one putt.

Motion pictures show clearly, better than any oral or written instruction, just how he does it. The above movie shot shows Armour in the follow-through after completing the stroke shown on the next page.

Made *Easy* by Movies

Pictures by Scientific Recreation, Inc.

Coo-Coo CONTRAPTIONS CONTEST!

Real Money for Nut Ideas

HERE'S your chance to win real money for a nut idea! Sharpen your pencil and concoct a Coo-Coo Contraption like the one on the opposite page—the "coo-cooer," the better. Rules of the contest are given below. You don't have to be an artist — anyone can compete.

STUDY the Handy Cigaret Lighter, the mechanism of which is pictured on the opposite page. We think you will agree with us that it is different from the usual run of cigaret lighters—it burns no alcohol or other expensive fuel, and is as dependable as the daily rising of the sun. The device suffers from the fact that it is not portable and cannot easily be slipped into the vest pocket, but with ordinary attention and regular inspections this cigaret lighter should last a lifetime, except for replacement of the cat and dog.

The Handy Cigaret Lighter is a Coo-Coo Contraption of the first water. The Coo-Coo field has been grossly neglected by the young inventor, and Modern Mechanics is going to offer monthly prizes to stimulate activity in this branch of modern science. Sharpen your pencil and your wits; concoct a contrivance that will put the cigaret lighter in the shade, and send your effort to the Coo-Coo Contraptions Editor, Contest No. 1, Modern Mechanics Magazine, Robbinsdale, Minn.

Remember, your contraption should be as humorous as you can make it. It need not even serve a useful purpose. The funnier, the "coo-cooer," the more far-fetched it is, the better is your chance of winning a prize. It is not necessary to diagram your device, although you may do so if you wish. Just write out a clear explanation of how your contraption works so that our artist can make a picture of it.

Winners will be decided by the editorial staff of Modern Mechanics, and an express condition of entry in the contest is that their decisions shall be final. Closing dates of the monthly contests will be the first of the month following the date on the cover. Thus Contest No. 1, beginning with this November issue, will close December 1, 1928. If your contraption arrives after this date, it will automatically be entered in the second contest.

Prize-winners will be announced and the winning contraptions published in the earliest possible issue after the close of the contest. Manuscripts will not be returned; if you wish to preserve your Coo-Coo Contraption, be sure to keep a copy of it. First prize will be $25.00; second prize $10.00; and five third prizes of $3.00 each. In case of a tie for any of the prizes, the full amount will be paid to each of the tying contestants.

Remember, you don't have to draw the plan for your "Coo-Coo Contraption" unless you want to, as the judges will decide the winners only on the idea submitted. But make it funny!

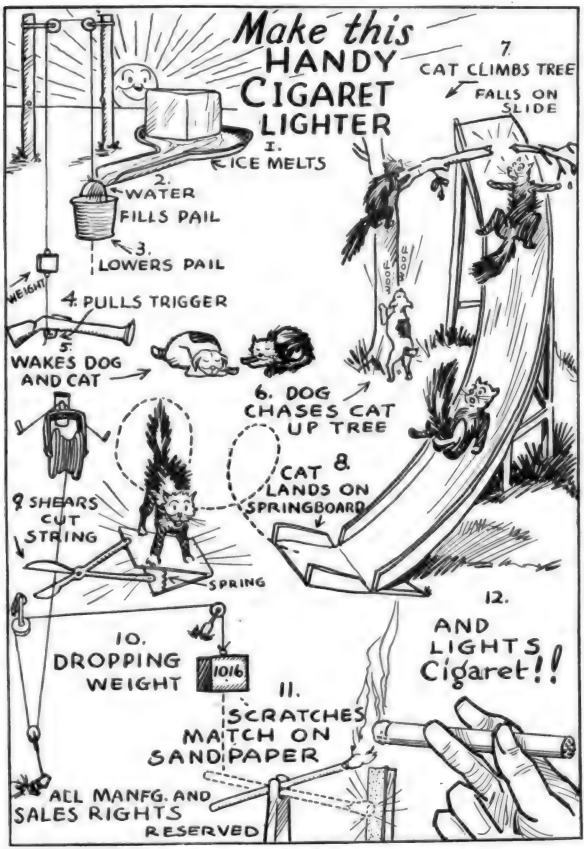
Sharpen your pencil and get busy!

WIN A PRIZE!

FIFTY dollars will be distributed each month among prize-winners in the Coo-Coo Contraptions contest conducted by Modern Mechanics. Prizes are as follows:

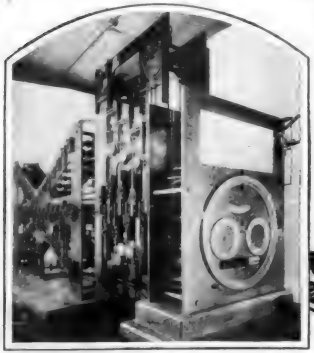
First Prize $25.00
Second Prize $10.00
Five Third Prizes..$3.00 each

Address your manuscripts to Coo-Coo Contraptions Editor, Contest No. 1, Modern Mechanics Magazine, Robbinsdale, Minn. Contest No. 1 closes on December 1, 1928. Manuscripts received after this date will be entered in contest No. 2. No manuscripts will be returned.



Start at No. 1 and See How It Works

BRASS BRAIN *Saves* U. S. $125,000 Yearly



Taking the place of a corps of trained mathematicians, this machine calculates the time of flood tides in all the ports of the world, enabling shipmasters to dock their liners safely.

IN THE rooms of the U. S. Coast and Geodetic Survey in the Capitol at Washington there stands a complicated mechanism of wheels and cogs known officially as "Tide Predicting Machine No. 2."

But to the men who operate it, and who have a very human respect for its uncanny ability to do the work of 100 trained mathematicians, it is known as "The Brass Brain."

And so, in truth, it is. Would you like to know the exact minute of the flood tide in Hong Kong harbor in 1980? Very well; put the problem up to the Brass Brain.

To begin with, you must take into consideration the 37 "constants," or factors representing specific phases of sun and moon in a given locality at a certain time, and and adjust the Brass Brain to accommodate them. Then simply turn a crank of the machine and the mathematical interaction of these 37 "constants" is transmitted to a dial and read by the operator. That's all there is to it; the Brass Brain has given you the answer.

Few mathematical problems are more intricate than this one of predicting tides. The relative "pull" of the sun and the moon, their distance from the earth and from each other, and a number of other factors must be considered.

The machine weighs 2,500 pounds. It is 11 feet long, 2 feet wide, and 6 feet high. Its whirring cogs are enclosed in a housing of mahogany and glass.

Earthquakes, fresh-water floods, and strong winds that cannot be predicted affect the accuracy of the Brass Brain to a degree. Nevertheless 70% of the predicted tides agree within five minutes of the observed tide. The Coast and Geodetic Survey issues an annual bulletin in which it lists the forthcoming tides in 84 ports of the world. The report contains upwards of a million figures, all compiled by the Brass Brain. It has been estimated that the Brass Brain saves the government $125,000 each year in salaries of mathematicians who would be required to take its place.

BLASTING ICEBERGS *with* LIQUID STEEL

Above is shown an iceberg drifting down from Greenland, heading to menace the North Atlantic shipping lanes. The size of these icy giants is graphically shown by comparison with the ship at the right. In the corner picture is shown the exposion resulting from detonation of a charge of thermite used to break up the bergs.

EVER since the steamship Titanic went down in the North Atlantic after striking an iceberg, mariners have realized that these tremendous mountains of floating ice present a serious menace to navigation. Various methods of removing these icy invaders from the steamship lanes have been suggested, but not until recently has science developed an effective weapon.

Thermite, a mixture of finely powdered aluminum metal and oxide of iron, is the destructive agent employed in blasting icebergs apart. Its use is recommended by Prof. Howard T. Barnes, of the department of physics at McGill University, Montreal. For 35 years Prof. Barnes has been investigating the physical properties of ice and practical methods of controlling it.

When properly ignited, thermite generates high temperatures and produces extremely hot liquid steel. Strictly speaking, thermite is not an explosive compound. The white-hot steel converts the ice into hydrogen and oxygen gases so rapidly that a powerful explosion results. Using this method, a huge iceberg can be split into fragments so small as to constitute no menace to commerce.

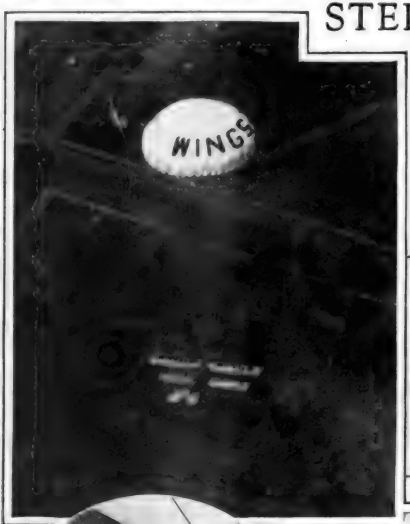
The energy from the molten steel supplies rays surpassing sunlight in their power to penetrate ice for many feet. Thermite is much used for welding trolley rail joints and for similar purposes.

Prof. Barnes believes that for a reasonable expenditure the menace of icebergs can be entirely removed from the steamer routes. Ice jams at power dams and bridges, which annually cause much destruction, can also be controlled by this simple method.

GOLF NOW PLAYED BY MACHINE

Several large hotels are now installing mechanical golf machines in their lobbies for the entertainment of their guests. The machines are inclosed with glass and the ball is set in motion and directed by means of a lever. Most of the machines provide a course of three holes, with traps and all the various hazards of the golfer incorporated. Score is kept by means of a dial attached to the front of the machine.

IT'S A LONG STEP DOWN!



AVIATORS who have to walk home when their gasoline supply gives out a mile above the earth will appreciate this airplane parachute! At the left an airplane with dead motor is drifting gently to earth. In the group below are H. Doucett, inventor of the device, Lieut. S. McDonnell, Army observer, and R. Carl Oelze, pilot of the plane.

—International Newsreel Photos.

Showing how parachute was stowed in airplane fuselage.

Here the airplane is shown immediately after landing. Note the parachute underneath the tail assembly.

Conducted by MAJOR H. H. ARNOLD

"Obsolete planes never should leave the ground," says Major Arnold in commenting on wise laws requiring licenses and inspection. He urges drastic action to make flying safe.

Needless Crashes Are Hurting Aviation

IT HAS not been very many years ago since everyone connected with aeronautics agreed that the pilot was responsible for 90% and the airplane 10% of the safe flights made by an airplane. Since that time the inventive genius of hundreds of engineers has been working on the mechanical side of aviation. The airplanes have been improved until they will almost fly by themselves under ordinary circumstances. The engines have been redesigned and constructed with better quality of material, until they seldom if ever fail in the air without giving the pilot an opportunity to select a suitable landing field.

Various and sundry accessories have been developed to insure the safety of the pilots and passengers. Parachutes which open in a trifle over three seconds are available for everyone. Instruments are incorporated in the airplanes which make it possible for pilots to fly through rain, clouds and even fog and reach their destination safely.

There was a time when a student aviator was turned loose to fly by himself as soon as he could make a safe landing. During the past few years the approved principles of instruction provide that the instructors teach the students everything possible to provide against the student ever getting his plane in a position from which he cannot extricate himself. There was a good reason for the early instructors turning their students loose to fly alone with so little instruction—the instructors knew but little more than how to take off and land themselves. Things are different now, however, for years of flying have demonstrated that there is no position which the airplane can fall into from which it can not be extricated.

In spite of all these improvements in the art of flying, there are still far too many accidents. Naturally as long as airplanes are mechanical devices there will be failures of different parts at some time or another. These failures can be greatly eliminated by proper inspection of the airplane and engine prior to flight, or better yet at regular prescribed intervals. The failures of the pilot can not be eliminated so easily.

There are Federal laws now which require both pilots and airplanes to be licensed if they are going to engage in certain kinds of flying. However these laws could not be made sufficiently drastic to require all planes and pilots to come under the Federal inspection system. Consequently there are many antiquated, obsolete airplanes being

THE editor of this department, Major Arnold, served as Assistant Chief of the entire American Air Service with the rank of Colonel during the World War. Later he became Chief of the 9th Corps Area. He is a veteran flier and a pioneer in aviation, universally known and liked. In line with the Modern Mechanics policy, "edited by experts," Major Arnold will personally pass upon the merit of all contributions to "Plane Talk."

flown today which should never leave the ground.

Fortunately most of the airplane companies have accepted the present day system and require frequent inspections of both airplanes and pilots but there still are a few of the careless type of pilots operating and too frequently the newspapers contain accounts of the results of their carelessness.

For the good of aviation, which has advanced by leaps and bounds since that master pilot Lindbergh came into prominence, we sincerely hope that all pilots and owners of planes adopt the Federal inspection system even though they are not required to by the strict letter of the law. If these unnecessary accidents continue, a time will surely come when all aviators will be compelled to comply with the regulations regarding inspection of airplanes and competency of pilots regardless of the kind of flying being done. It may take some such drastic action to make flying safe for everyone.

Helicopter Airplane Tested in Berlin

Four helicopter blades are intended to lift this machine into the air.

THE new type of flying machine shown in the picture is equipped with a huge four-bladed propeller mounted on the fuselage just in front of the cockpit.

The big propeller is designed to lift the ship into the air, while the blade in front is of the regulation type to give the machine forward motion. The extremely short lower wing is a noticeable feature of the machine, a large wing area being unnecessary because of the lifting power of the helicopter blades.

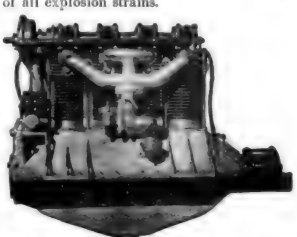
The ship is of Spanish design. It has been flown by the English aviator, Col. Courtney, at the Tempelhof Airdrome in Berlin, where the inventor is carrying forward his experiments.

Wartime Air Engine Converted

BY THE substitution of nickel-iron cast cylinders and aluminum alloy cylinder heads for deteriorated water jacketed cylinders the war-time Hall-Scott A 7 A four cylinder motors have been brought into line with the latest ideas of air-cooled airplane engine design.

On a bore of 4.5 inches, a stroke of 7 inches, and with a compression ratio of 5.3 to 1, the motor develops 110 h. p. at 1,550 revolutions per minute. It weighs 375 pounds.

Full forced lubrication is used, the motor base holding sufficient oil for six hours' duration as a wet sump engine. The base, by means of an auxiliary oil pump, can be used as a dry sump engine with separate oil supply. The crankshaft is five-bearing, backed by steel-backed main bearings attached to the cylinder head by long steel through-bolts, thus relieving the crankcase of all explosion strains.



This Hall-Scott engine is brought up-to-date by embodying latest improvements.

Aluminum alloys play a prominent part in the new conversion. The aluminum cylinder heads, of spherical chambered type, have bronze valve cages set in. Pistons are of aluminum alloy, and are floated on the wrist pin. There are three rings in the piston heads. The base, containing the double ball thrust which allows the motor to be used as tractor or pusher, is also an alloy of aluminum.

Milk Counteracts "Wing Dope" Poisoning

MEN who apply "dope" to airplane wings in commercial and government factories are required to drink from one to three quarts of milk daily to counteract the injurious effects resulting from unavoidable breathing of the fumes given off by the "dope." Wing "dope" is the same sort of liquid as the familiar New Skin compound which is used to put a collodion coating on cuts and bruises.

Airplane wing "dope" dries almost on the instant it is applied, drawing up the fabric as tight as a drum-head. It gives off fumes with a characteristic pungent odor similar to banana oil, which if not counteracted by milk drinking tend to bring about early consumption in those exposed to the fumes.

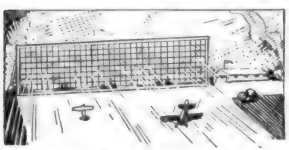
The counteracting effect of the milk is explained by the fact that fatty particles adhere to the throat lining, where the lactic acid interacts with the inhaled fumes to make them harmless.

These factory workers drink milk to avoid contracting tuberculosis.

Man-Made Gales Help Airplanes Land

HUGE fans which can whip up a 65-mile gale that will act as a brake on landing airplanes will be the next piece of equipment installed in the modern airport, according to experimenters.

Aviators have long known that it is easier to land in a stiff breeze than in still air, and



it is proposed to take advantage of this fact by arranging twelve to twenty fans on the landing field to supply an artificial gale.

The fans would be arranged at the end of the field to cover a section 200 ft. wide and 90 ft. high. The air would be driven through a screen of steel bars one inch wide and two feet apart. This screen would serve to break up the eddies of the air.

Flying into this man-made breeze, the aviator would be able to land in the small space of a city block, or even on top of a moderate sized office building.

The fans would be equally helpful in aiding the plane to take-off, for the angle of the ascent could be increased from 20 degrees to 50 degrees with a 65-mile gale furnishing lifting power for the wings.

By cutting down the space necessary for a plane to land, department stores will be able to maintain landing facilities on top of their buildings for the convenience of shoppers. This would aid immensely in popularizing the airplane for everyday uses.—*Science Service.*

How the *S-4 Might*

Jim Frazer, famous Navy diver, who helped raise the ill-fated S-4.

SINCE the tragic loss of the S4 and all its crew another submarine catastrophe has shocked the world—the sinking of the Italian submarine F-14. What can be done to save the victims of these crashes? Modern Mechanics presents here one solution, devised by James Frazer of the U. S. Navy, which has the merit of providing prompt relief.

FORTY men were facing death in the wrecked submarine S-4. Above them the *Paulding*, which had cut through the submarine's hull, radioed frantically for help.

Yet, from the moment of that terrible crash those men were doomed. They knew it; Navy men knew it. Four months had it taken to raise the S-51 when the *City of Rome* sent her helpless to the ocean's floor. It would take months to raise the S-4.

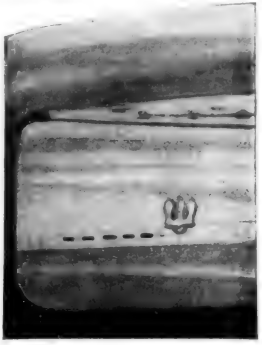
And the whole nation, reading of the disaster with horror, asked "why can't they be saved?"

The answer was simple enough; they couldn't be saved because there was nothing to save them with. A submarine is a machine of war, not a peace device. It is not equipped with the safety factor uppermost in the minds of designers.

Everything was done that could be done under the circumstances. Divers risked their lives in those icy waters. Submarine tending ships fought the storm and high waves in order that the hopeless work could proceed. Tunnels had to be blown under the hull by a powerful hose boring in the mud. Chains had to be attached, pontoons lowered and put into place—a gigantic task even in calm weather.

There were no inlets in commission that could provide the men with life giving air. The control room, as usually happens, was the first to be flooded, and the men were trapped in the extremities of the ship. Hence the airlock in the control room was of no use. The internal bulkheads, separating the submarine into compartments, had failed as safety devices. Because of the shafts that pass through these bulkheads they always permit water to seep through, and this was what hastened the death of the thirty-four men in the S-4's engine room.

While part of the crew remained alive the whole nation seemed to suffer with them. From far and wide came not only frantic pleas to rescue the doomed men, but scores of suggestions as to how to do it were presented as well.



Have Been Rescued

by JAMES FRAZER

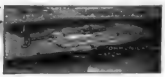
Chief Torpedoman U. S. Navy

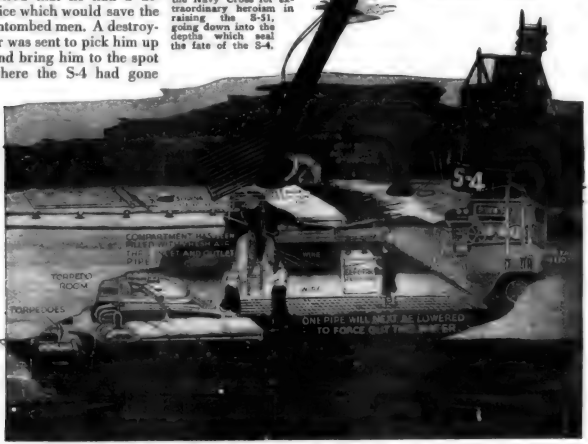
Having been the assistant diving supervisor in the salvage work of the S-51, which was rammed by the *City of Rome*, I was sent to the scene of this latest submarine disaster. I listened to many of the desperate plans proposed, and the Navy withheld nothing in the way of assistance to those whose schemes had the ghost of a chance to succeed.

An Indiana mechanic wired that he had a device which would save the entombed men. A destroyer was sent to pick him up and bring him to the spot where the S-4 had gone

Below: Detail of the sliding gate valve used on hull.

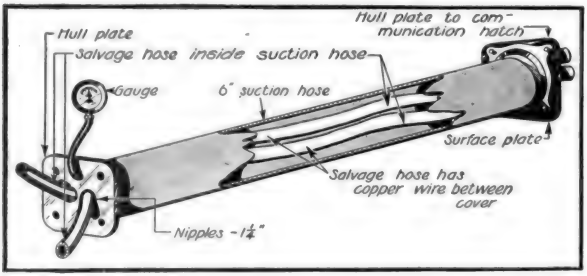
Jim Fraser, holder of the Navy Cross for extraordinary heroism in raising the S-51, going down into the depths which seal the fate of the S-4.





Sealing the gasket to the suction tube. Communication with the stricken vessel gives light, heat and air to the crew.

Details *of the* Salvage Device



down. He saw the mountainous waves, admitted he had never been on the ocean before and "had no idea it was like that!" He left his device in his bag and went home.

A botanist proposed that flowers be thrust into the torpedo room, on the theory that the men within could turn electric lights on the flowers, which would absorb carbon monoxide gas and give off oxygen.

Another plan proposed that battleships be anchored over the spot, with their sterns toward the sunken craft. Chains could be attached to the submarine and fastened to the propeller shafts of the battleships. Then the engines could be set to turning, and up would come the submarine.

Even that incredible plan was given consideration, but a submarine weighs 850 tons, while the propeller shafts could stand a strain of only 40 tons. Moreover, pontoons would do the job, once chains were attached, which was the biggest job.

Lifting Cranes Impracticable

The most favored scheme among those put forward called for the use of huge lifting cranes. But cranes must ride on the surface, rising and falling on the waves, while a submarine when sunk is a dead weight. One moment the cranes would be up on the crest of a wave, tugging away at full steam, and the next they would drop into a trough, the engines would race taking up slack, and the chains would snap as another wave brought up on the chains too quickly.

Those are only a few of the desperate methods suggested for raising the submarine. Preposterous ideas for safety devices were to come later from every point of the compass.

It took almost three months to raise the submarine. The operation cost thousands of dollars, and entailed the ceaseless risk of other human lives as the divers tunneled under the stricken submersible, sank pontoons, and attached chains. Lt. Commander Edward Ellsberg nearly lost his life when his lines tangled in diving. Diver Eadie saved Diver Mitchell's life in a hard fought battle against time.

The only successful attempt to get air into the S-4 was managed by coupling an air hose to the SC tube over the torpedo room. This is a sounding apparatus, and not intended for the use to which it was put, and of course would have helped only the men in the one compartment.

Since the S-4 disaster many articles have been written, safety inventions proposed, and inquiries launched, and tomorrow, if the sister ship of the S-4 went down, we would face the same problem, with the same handicaps.

Something must be done to reduce the dangers of submarine work. Every emergency can't be provided against, and there will be future losses—but certain steps can

The stern of the U. S. S. Falcon, Uncle Sam's salvage ship. Here the oil stored in the S-4 is being transferred to tanks aboard the Falcon, through the salvage hose shown going over the rail on which the sailor is sitting.

be taken, and should be taken, in preparing our under-water boats against disasters.

They call our submarines steel coffins—and with good reasons. But let's give the men in them at least a fighting chance for their lives. Navy men know the risks they must take on submarine duty, and they expect no coddling; they are our fighting men, and fighting men have dangerous work to do. They don't ask for complicated contraptions that would hamper the effectiveness of a submarine in warfare. But they have a right to expect *some* safety devices.

No one has a right to criticise destructively—and such is not my intention. I would not speak up now if I did not think there is room for constructive opinions on the matter, and if I did not feel prepared to offer a possible solution.

My device has been submitted to the Navy department, and will be acted upon in good time, along with many other plans which must all be carefully considered by experts. This device is based on eighteen years of service with the Navy, and on considerable diving experience, so that at the outset I have eliminated some of the main objections to submarine safety devices proposed by inexperienced men. There are several facts which must be borne in mind when designing rescue apparatus.

These devices must not be cumbersome.

They must be simple in the extreme.

They must not interfere with the fighting efficiency of the craft.

With these requirements uppermost in my mind, a communication hatch was worked out which would prolong the life of the imprisoned men and provide an opportunity to raise the submarine by pumping her out.

Imagine a wrecked submarine lying several hundred feet below the surface. Some of its compartments are flooded; others may have been only partly filled before the leaks were plugged by the confined men.

The rescue ship locates the submarine

—International Newsreel.

The most magnificent sight in the world! This is said by those who saw the S-4, pictured here, as she broke the surface after her long undersea imprisonment. Foaming sea water covering an area a block square blistered the surface as the air escaped to equalize internal pressure in the ship.

Salvage Suggestions

One of the fantastic suggestions put forward for the rescue of the S-4 was that of a florist who proposed that flowers be inserted through the torpedo tubes of the submarine and that powerful electric lights be turned on them. The idea was that the flowers would give off oxygen, at the same time consuming poisonous carbon monoxide.

and sends a line down to grapple it. A diver puts on his suit and slides down the line—perhaps within a half hour of the sinking.

Tapping noises sound under his feet as he walks along the steel hull.

Men are still alive in that compartment! He signals quickly, and a long, six-inch hose comes snaking down through the dim ocean depths. The diver grasps the hose and sets its end over a square plate on the submarine's hull, screwing it tightly in place.

Another signal, and above him the men on the tender start pumping out the hose by closing it at the upper end and forcing air into it. The diver discovers that other men are alive in another compartment. Another hose is lowered.

By this time the first hose is emptied. Within the big hose are two long pipes and a smaller one. The pipes are wound with copper wire. One pipe was used as a lead for pressure, the other as a spill pipe, when the hose was emptied of the water.

Now the diver opens the communication hatch on the submarine, or signals to the men to do so by tapping his message on the hull. There is now an open hose leading into the submarine from the tender above. Cries of relief and joy can be heard by the men on the surface.

The two salvage hose are lowered until they reach down inside the submarine. Already the air is bad in there, and the pumps start work sending air to the trapped men. One pipe sends in fresh air, the other draws out the impure air.

Food Carried Through Pipes

Because the pipes are copper wound, and insulated by a rubber sleeve where connections are made, the confined men are able to connect them by wire to their electric radiators, which can be removed and hung up anywhere, and the electric lights. Usually the batteries go dead when the submarine sinks, due to water flooding in.

Hot food is run down the pipes as soon as the air is cleared. Then the imprisoned men, using the pipes as voice tubes, inform their rescuers as to conditions in the submarine. The water, they say, is up to their knees, but they have the bulkhead doors plugged so that no more will come

in. Other compartments report the same flooded conditions.

One of the two main pipes is lowered still further into the submarine, until it touches the floor, below the water in the compartment. The smaller pipe is connected to a pressure gauge, and then the suction hose is closed at the top by attaching the surface plate.

Once more the air pump starts operations. The pressure in the compartment slowly increases, with divers on the tender keeping a watchful eye on the pressure gauge. Too much pressure would kill the men.

Suddenly at the surface above the spill pipe gushes forth oily water. The pressure inside the submarine is sufficient to drive up the flood of bilge water!

In other compartments the same operation is going forward. Far back in the motor room, swift death overtook all the hands caught there. The whole room was flooded. A diver has opened that hatch and without the aid of the men inside, has sent the pipes down so that the water can be forced out.

A sudden storm comes up—waves mount higher. It is necessary to abandon the work—and buoys are anchored to the hoses rising from the submarine. The storm abates and work is resumed.

Abruptly, great bubbles rise from the bottom of the ocean, bursting whitely on the surface, and sending water upward in fountains. The submarine has stirred—it is becoming buoyant!

In spite of the great gap in one of the compartments, which cannot be emptied of its water, the craft is slowly rising to the surface. The pumps work faster, and more water spills out. And then the submarine breaks the surface of the water. The men are saved!

Grappling chains hold the craft fast, and it is towed ashore. The steel hull, meanwhile, is being drilled through with torches, and already one compartment has been opened, and the men released. They walk along the floating submarine and climb aboard the tender as they are towed toward shore.

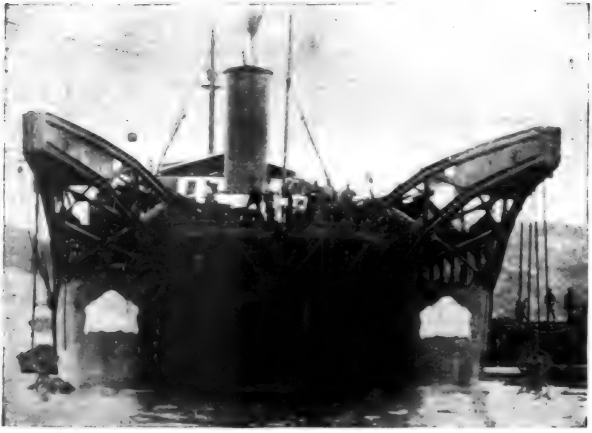
A dramatic moment in the raising of a sub. The nose of the S-51, sunk a year before the S-4, is here shown as her bow lifted to the surface for a moment, only to slip away and be lost again!

Saved by a 6-inch Tube

How has this been accomplished? By the use of a simple hatch over each compartment, and on each side in case the boat lies on its back, or side. The hatch can be removed either by the diver, or the men inside. The hose that is connected to the hatch may be four to six inches in diameter, of the non-collapsible type. Inside the big suction hose are the salvage hoses, or pipes, wound with copper so as to be conductors of electricity.

The hull plate is matched by a surface used on the surface end of the suction hose, to close the hose tightly. Then the salvage hoses clear the main hose in the manner already described. Two 1¼-inch nipples provide openings for these pipes on the surface plate, and another nipple provides for a place where a gauge can be attached.

This gauge, showing the air pressure, is used when there is an opportunity of raising the submarine without resorting to pontoons. Attaching pontoons at this time, since the submarines have no lifting eyes, requires tunneling under the craft with a huge water hose. This hose spouts a big stream forward, and five rearward, so as



—International Newsreel.

This submarine mother ship is the type used in raising the sunken Italian submarine F-14. The huge ship straddles the submarine. It is provided with powerful lifting cranes.

to enable one diver to handle it. The hose having dug the tunnel, the divers crawl through it, dragging wires after them. The wires then carry the chains through to form a cradle for the craft.

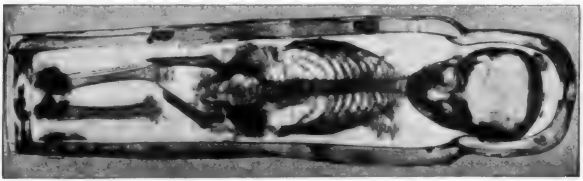
When the submarine has been lightened sufficiently to begin to rise, the gauge is watched with exceeding care. As soon as the craft floats, the pressure must be slowly diminished so that the men inside can be released under normal atmospheric pressure. This is done by reducing the pressure, according to the gauges, by slow degrees. If the men were brought from high pressure into normal pressure, they would suffer the dread tortures of the "bends."

Electric radiators heat the submarine, and if the battery compartment is flooded, as was the case with the S4, the men are left without light or heat.

Now, by wrapping the pipes with copper, and insulating them by means of rubber sleeves at joints where salvage hose is connected, electricity can be conducted into the submarine. Radiators are detachable, and these can be hung above the flood line, wires attached to the copper pipes, and heated. The electric lights may also be wired in the same fashion.

I have omitted technical details which may confuse the reader, but these have been worked out so that there is nothing left unsolved. The device is simple, and it will work. After the water is out of the hose, which is flexible but non-collapsible, you have the same effect as looking down a well, and with this direct communication all manner of rescue plans could be carried out if unforeseen problems arose.

X-Ray Detects Disease in Mummies



—Photo by Field Museum.

This mummy of Tediamon, Egyptian boy of the seventh century B. C., shows how joints were broken and arms left out in the mummifying process.

THE X-ray is the latest instrument of science being empolyed by experts in photographing Egyptian mummies to determine the nature of the diseases which ravaged the ancients. The above X-ray of an Egyptian boy's mummy is interesting in its disclosure of the fact that he suffered from malnutrition. Scientists determine this from the irregular development of the ends of the long bones, indicating deficiency of calcium in the diet. Photographs of other mummies show distinct curvatures of the spine. Teeth condition is also studied from the photographs.

The advantage of the X-ray is that the bone structure of the mummies can be studied without unwrapping the body, with the consequent lowering in value of the mummy as a museum specimen.

THE DADDY OF THEM ALL

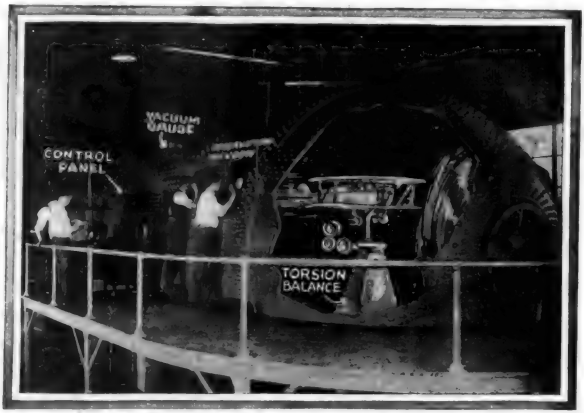
A GERMAN watchmaker has constructed an alarm clock that is almost a yard high. When the alarm goes off it sounds like a boiler factory in full activity, according to the designer. An idea of the immense size of the clock may be gained by comparing it with the regular-sized timekeeper in the watchmaker's hand. Note the second set of figures under the hour numbers, running from 13 to 24, making the clock conform to the 24-hour day in use in some parts of Europe.

—Keystone.

NO WATERWORKS IN KEY WEST

Rain water collected in cisterns is used for drinking purposes in Key West, Florida, said to be the largest city in the United States without a waterworks system. The population of 20,000 hopes to tap a water supply from artesian wells; failing in this it is necessary to go 120 miles to the mainland of Florida for potable water. Wells drilled to a depth of 60 feet strike an inexhaustible supply of salt water which is used for fire protection, but is useless for human consumption.

Hurricanes Test Airplanes in Wind Tunnel



TERRIFIC wind blasts created inside the world's largest wind tunnel, shown above, made it necessary to build the structure of heavy battleship plates to withstand the tremendous pressure. The tunnel is located at Langley Field, Virginia.

Model airplanes are mounted on special pedestals inside the tunnel and their reaction to the artificial wind gusts is carefully observed and recorded by means of delicate instruments. Latest advances in aerial engineering are tested in the wind tunnel before they are incorporated in man-carrying planes. Observation windows of special shatter-proof glass are cut into the steel shell of the tunnel so that investigators can keep an accurate check on the peculiarities of various airplane models.

—International Newsreel.

LUMINOUS LICENSE PLATE

Identification of motor cars at night is made easy by an illuminated license plate being introduced in Melbourne, Australia. The license figures are imprinted on a glass plate behind which is a powerful electric lamp, which shines through the figures and makes the license easily read on the darkest night. Compulsory adoption of such plates is expected to aid in the after-dark detection of hit-and-run drivers and other motor car offenders. The picture at the right shows the inventor with his license plate attached to an automobile.

New Camera Photographs Chicken in Egg

—International Newsreel.

HEARTBEATS of an unhatched chicken inside an egg can be photographed with the marvelous new camera machine invented by Carl Dame Clarke, medical illustrator at the University of Maryland. The inventor is shown in the picture at the left focussing the microscope attachment of his machine on an egg. The device is a combination eight-day clock, motion picture camera, and powerful microscope. Activities of germs and the growth of flowers can be photographed in motion by the delicate camera.

Film in reels, similar to ordinary movie film, is actuated by the clock mechanism so that pictures are automatically exposed at predetermined intervals. The object to be photographed is enclosed in a dark chamber and a powerful light turned on under the base on which it rests. The machine is expected to be of great value to scientists in studying the secrets of nature.

BOLIVIA, WITHOUT SEAPORTS, TAKES TO AIR

BOLIVIA, the only country in South America without a seaport, is developing an extensive Air Service to connect it with the outside world. A fleet of Junkers airplanes was recently christened at La Paz. Flying in Bolivia requires planes of high efficiency because of the rare mountain atmosphere, the country being one of the loftiest in the world, with an average elevation of 12,000 feet above sea level. The country lies between three of the highest peaks in America, which airplanes must fly over to reach the outside world.

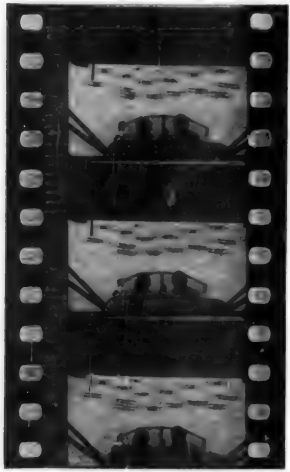
Christening ceremonies for the new Junkers airplanes added to the Bolivian Air Service are pictured above.

What Makes the Movies Talk?

By William F. Crosby
Electrical Expert and
Radio Engineer

Millions of people have heard and seen the new talking movies, but the theater-going public knows little about the machinery that makes this form of entertainment possible. In this article Mr. Crosby writes authoritatively of the development of the talking movies, being an electrical engineer who has made a study of the sound devices.

SPEECH reproduction as an accompaniment of motion pictures has been perfected to such a degree that the common variety of silent movie promises to become something of a rarity. Even the 100-seat side-street theater will soon be able to cast out its old mechanical organ and give its patrons the same high quality musical accompaniment that distinguishes the presentations in the largest movie palaces.



This enlarged reproduction of a strip of "talking" film shows the sound track running along the left side, through which light is projected to operate the talking device.

There are several different systems coming into wide use and many motion picture theatres throughout the country are being equipped with such apparatus as quickly as possible. Within a year nearly all of the major pictures and many of the minor ones will be available with means of reproducing either musical accompaniment or the voices of the actors. The talking movie systems are all closely allied and the differences in quality seem to be largely matters of personal opinion.

There are three major systems of movie voice reproduction. Briefly, these are: the film on which the music or voice is photographed directly; the use of a record which is operated in synchronism with the motor of the projection machine; and the third system which is not operated in synchronism but is manually operated by a trained expert.

Photographing Human Speech

The first system is probably the most interesting of them all, for it is here that sound waves are turned into light and then back to sound waves after passing through apparatus as electrical waves. The entire success of this system depends upon a little device known as the photoelectric cell, a device not much larger than the vacuum tubes used in most radio sets. This photoelectric cell is sensitive to light rather than to pulsations of electricity. The tube itself is entirely enclosed in an opaque covering

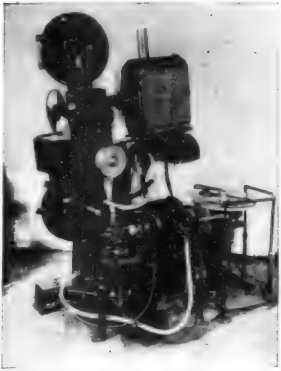
except for a small window through which a beam of light is directed. When there is no light the cell has the property of conducting full electrical impulses, but as the light gains in intensity the current drops off accordingly until, at full brilliance, there is no flow at all. Its response to each graduation of light is instantaneous.

Suppose that the camera is set up and we are ready to take a picture by this method. If recordings of the actors' voices are to be made, it will be necessary to set up supersensitive microphones about the studio, arranged in such a way that we can cut in or off instantly any group of "mikes." If the musical accompaniment only is to be made, this work will not be done until after the picture is finished and ready to show, when the usual score will be made and the music run off at a showing of the picture.

The sound is picked up by the microphone and is amplified in a device which is almost exactly like the ones used for radio purposes, except that it is larger and incorporates much finer apparatus than is usually found in such devices. These instruments represent just about the highest degree of manufacturing skill.

If there are several microphones to be used, each will have an amplifier and a control by means of which the operators can handle the situation from outside the "set." All of these amplifiers then feed into a "mixer" panel where there is usually another amplifier and the resultant of this device is then brought to a device which operates something like the mechanism of an ordinary dynamic loud speaker, except

Movietone productions use this simple attachment on the projecting machine. Details are shown in the diagram on page 114.



This projecting machine is equipped for sound reproduction by both disc and film methods. The sound machinery is enclosed by the iron railing.

that instead of reproducing sound, the vibrations cause a highly polished metal surface to move in exact accordance with the impulses.

Light Turned Into Sound

A ray of light reflected from this polished surface is photographed on the film along with the action of the picture. The entire musical or audible part of the film is concentrated into a strip on the edge of the film, this strip being only one-eighth of an inch wide. It is called the sound track and when the film is developed and the prints made, each one will have the music or voice printed along with it as a part of the film itself. The sound track will appear like a lot of fine horizontal lines ranging from light to dark according to the accompaniment.

In the projection machine, used to throw the picture on the screen, a strong arc light passes through the film itself and thus projects the picture as desired. The sound track is screened off from this light and another and smaller light, called the exciting lamp, casts its beam through a care-

Three Methods of Sound Reproduction

fully regulated lens and thence to the sound track. It passes through here in quantities in exact accord with the number of horizontal lines, to the photoelectric cell where the light ray is again converted back to electrical impulses which are exactly like those that came from the microphone and in accordance with the theory of the photoelectric cell as already explained. This part of the equipment might be likened to the detector in the radio receiving set.

This simple fluctuating electrical current will change with each change in light and shade in the film and it is a simple matter to feed the electrical output of the photoelectric cell into a line amplifier where it is eventually sent out on a wire that runs back stage to a series of especially designed loud speakers, far larger than anything used for home radio entertainment, yet almost exactly the same in shape.

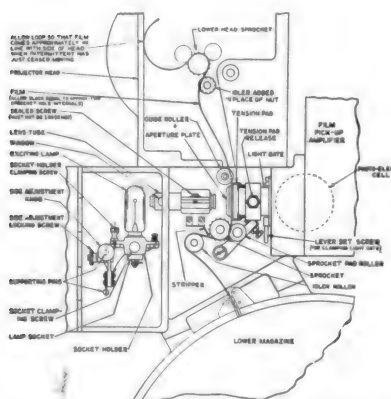
The output of the amplifier may be sent through several of these speakers at the same time, giving the effect of great depth of tone. The speakers are placed in back of the screen, which is opaque enough to permit the picture to be fully visible yet has the property of permitting the sound waves to pass throughly freely, thus giving the effect of sound actually emanating from the lips of the shadow figures on the screen.

Speed Must Be Regulated

Ordinarily, film is exposed through the camera at a somewhat slower speed than the rate used in projection but, obviously, with this system it is necessary that the film should be run at equal speeds on both occasions. Speeding it up in projection will cause distortion in both voice and music. The same thing applies to an ordinary phonograph where, if it is speeded up too far beyond the normal speed of 80 revolutions per minute the music will become shrill and high pitched, entirely unlike the original reproduction.

Another popular method of securing somewhat the same results makes use of an especially made record which operates along lines somewhat similar to those of the ordinary household phonograph. Here, too, microphones and amplifiers are used, but the sound is impressed upon a master record from which other records may be made as needed.

Ordinarily, the reproduction of sound from the record thus made, would take place with the tone arm and horn, but this would be impractical for it would mean that the apparatus, including the horn, would have to be placed in the projection booth, thus destroying



Details of the mechanism used in projecting sounds that have been photographed on the film are shown in this diagram. A picture of the attachment will be found on page 113.

much of the illusion. If the machine were assembled back-stage in the theatre, it would be next to impossible to have it run in synchronism with the projection machine.

Magnet Regulates Sound

Again electrical engineering has come to the rescue with a simple little device which is really a generator of minute electrical energy. An exceedingly small horseshoe magnet forms the basis of this device, and between the poles of the magnet a small coil of wire is so fixed that the needle in travelling over the bumps and hollows of the record will cause a slight movement of this wire coil. The result is a small electrical current which is in exact accord with the original sound reproduced and a great improvement over the older types of non-electrical sound boxes.

Best of all, the output of this little magnetic unit may be fed into two wires which may be led anywhere to an amplifier and thence to the usual array of loud speakers. Thus the tone arm is done away with and the output of the record may be brought to any point where a wire may be run. The device is as simple as it is effective and is being widely used on modern phonographs by leading manufacturers.

This type of record runs in exact synchronization with the projection through a turntable which is geared to the same motor that runs the projector. The records are not of the standard variety, but are somewhat larger and are designed to revolve at a much lower speed than usual, thus making it possible for one record to last throughout the showing of a reel.

Horns as tall as a man are placed behind the silver screen. This is one of the giants which the audience never sees, but which is vital in making the movies talk.

In this strip of "talking" film the microphone used in recording voices can be seen in the lower left corner.

Records Are "Faded"

The change from reel to reel and from record to record is accomplished through the use of two projectors and, of necessity, two turntables, with a device known as a "fader" which, as the first record nears its end, permits the first one to be faded out and the second to be faded in just as the change in film is made from one projector to the other. The music at the start of one record will overlap the music at the end of the other making it possible for an experienced operator to make the change from one record to the other without the audience being aware of it. This same fading idea has been in use for a long time in shifting from one film to the next so that there shall be no break in the continuity.

Another method, and one that is closely allied to the one just outlined, is called the non-synchronous system in which the record is turned on an entirely separate turntable at speeds in accord with the requirements of the film. This is work for an expert operator, but the system has been in successful use for some time.

This record is "cued" so that the opera-

tor can tell where it should be changed if necessary, and it has the added advantage that the operator does not necessarily have to be in the projection room, but can be anywhere in the theatre so long as he can see and hear what is going on. It is also unnecessary to have special low speed records for this work, and some of the phonograph companies are already turning out such recordings to go with certain pictures.

The ordinary theatre orchestra may be played for a certain part of the film, but during the most exciting parts it may be desirable to have the voices of the actors heard instead of stopping for sub-titles. Through the non-synchronous system this is possible although it may be adapted to the other systems as well.

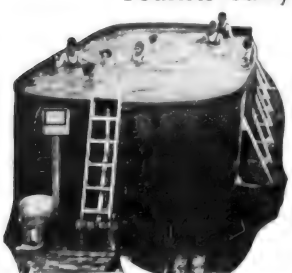
Talking Doubles for Actors

Continuous music may also be had through this system by the use of two turntables arranged so that the operator can fade from one to the other and, through a simple speed control, be enabled to regulate the speed to conform perfectly with that of the record. Special guides are sometimes used by means of which parts of the record may be picked out at will. Of course the same amplifiers and back-stage loud speakers are used with this system as in the others and many theatres are equipped to use any of the three systems according to the film being shown.

In addition to these uses, the line amplifiers and speakers may be connected to a microphone in the manager's office, thus permitting special announcements to be made audible to the entire audience. Should the theatre be poor acoustically, the use of a microphone on the stage will add greatly to the audibility of vaudeville acts or special presentations and since the loud speakers are usually mounted on easily portable towers, the problem resolves itself into a rather simple affair.

These various systems and their closely allied kith and kin are generally pronounced by experts to be far superior to anything heretofore available. The entire industry is rapidly taking up the work and inside of a year or so it is predicted that the better films will have musical accompaniments equal to the finest theatres of the land. Just what will happen to some of the most popular film stars when it comes to recording their voices is a matter of much speculation and it may be more than possible that there will be "doubles" employed solely to give a fine speaking voice to some otherwise handsome idol of the screen.

Tourists Carry Swimming Pool



—International Newsreel.

This giant bath-tub is a portable, collapsible swimming pool designed for tourist camps.

SUMMER camps are equipping themselves with the latest luxury for auto tourists in the shape of swimming pools which can be erected anywhere, ready for use when filled with water. The portable pool, which looks like a giant horse-trough, is manufactured of waterproof fabric stout enough to resist the water pressure. Light metal buttresses are used to support the sides of the tank. It is possible to swim in the heart of a desert if this tank and enough water to fill it is carried along.

ELECTRIC MOTORS POPULAR IN FRANCE

Twenty-five manufacturers turn out between 200,000 and 225,000 small electric motors yearly in France, according to figures recently published.

Single Tree Furnishes Lumber *for* Church

WHEN they decide to build a new church out in Santa Rosa, California, members of the congregation go out and select a likely young redwood tree and cut it up for lumber. If the church is of average size, like the one in the picture, the chances are that enough lumber will be left over from the single redwood to start a parsonage for the pastor. Only two-thirds of a redwood tree was used in constructing this California church, and when the roof was finished it was found that 60,000 shingles were left over.

The building is 60 feet wide, 100 feet long, and the spire rises 100 feet in the air. In addition to the main auditorium seating 400 people, the building contains a large study for the minister, a vestibule, and a parlor with a seating capacity of 100.

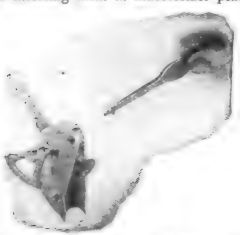
One huge Redwood tree built this California church.

—Keystone.

Families planning to cut down the cost of building their own homes by planting redwood trees in their back yards are warned that it takes several thousand years for these giants of the forest to mature.

SCREW HOLDER MADE FROM OLD COIL PARTS

There is an endless variety of screw holders or devices to grip and retain screws while inserting them in inaccessible places.



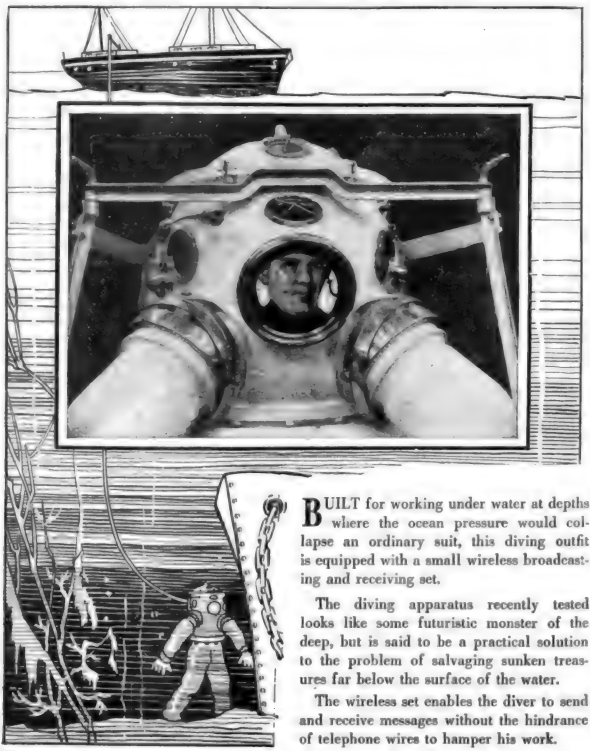
Some holders have more mechanism than a printing press. The photo shows a simple affair made of two old vibrator hammers from a Ford coil box. The points are removed from the outside edge of the circular end and a small rivet put in to hold them securely together. The bridge ends are cut off and down to a driver point to take the screws. A wad of paper or sliver from a match is wedged between the riveted halves, spreading them out to get the spring necessary to hold the screw. It is a light affair for small light screws, found in everything from the radio to the washing machine, and parts for making it are readily obtained.

HUMAN NERVE FIBERS EMIT LIGHT

It has long been known that certain light emanations from living plants and animals can effect photographic plates. Latest discoveries of experimenters tend toward the theory that the nerve fibers emit a feeble radiation which is beyond the visible spectrum when the nerves are at rest, but which is transformed by fluorescence when the nerve is stimulated.

Divers Get Wireless Messages

Huge diving suit built for work far below ocean surface carries broadcasting set and headphones for communicating with tenders.



BUILT for working under water at depths where the ocean pressure would collapse an ordinary suit, this diving outfit is equipped with a small wireless broadcasting and receiving set.

The diving apparatus recently tested looks like some futuristic monster of the deep, but is said to be a practical solution to the problem of salvaging sunken treasures far below the surface of the water.

The wireless set enables the diver to send and receive messages without the hindrance of telephone wires to hamper his work.

Sparks from the Radio Editor

Conducted by CHARLES MAGEE ADAMS

The editor of this department, Charles Magee Adams, is a nationally known radio expert who has been advising amateurs for years how to get the best service out of their sets. If your receiving set requires the advice of a radio "doctor," or if you wish any information concerning the operation of your radio, send your questions to Mr. Adams in care of Modern Mechanics Magazine.

Extension Cords for Loud Speaker

WHEN a receiver is equipped with a separate loudspeaker fans find the use of an extension cord quite convenient since it permits the speaker to be moved to any part of the house.

It has often been assumed that such an extension cord decreases volume by introducing resistance in the speaker circuit. But experience has shown that the loss of volume caused by using the longest standard cords cannot be detected by the ear, since the cord's resistance is so small compared with that of the speaker windings as to be negligible at the high plate voltages now used in last audio tubes.

Accordingly, it is economical to buy a cord of the greatest length that will be needed. When it is desired to use the speaker in locations not requiring the entire length the slack can be coiled up out of the way without fear that volume is being sacrificed.

The cord should be well insulated, preferably with a rubber covering adjacent to the wires, this to prevent possible short circuit in case of accidental wetting.

The connector at the speaker end should be of a type that completely encloses the cord tips. There will then be no risk of short circuit or shock.

It is recommended that the cord be kept off the floor at points where it is likely to be stepped on. Such treatment would damage both the insulation and the small wires of which the conductors are made.

Ordinary lamp cord may be substituted for the regulation speaker cord with fairly satisfactory results. But its price is generally greater, and there will be the complication of making proper connections with the speaker cord-tips.

Clean the Ground Clamp

ONCE it has been made, most fans forget the connection between a radio receiver and the water pipe which forms the usual ground. But this needs attention several times a year, because the oxidation which takes place will otherwise increase the resistance of the contact and reduce the efficiency of the installation.

Remove the ground from the pipe and bring both its inside surface and the outer surface of the pipe to a bright polish with fine sandpaper or emery cloth. Then replace, tightening the clamp securely.

The few minutes required will be amply rewarded by greater volume and increased sensitivity on distant stations.

Cleaning the A Battery

THE most disagreeable by-products of a storage A battery are the dirty gum which coats its top and case, and the corrosion of terminals, both caused by the acid spray given off during charging. The easiest and most effective way to remove these and prevent their further formation is with a damp rag.

Disconnect the wires or clips from the terminals. Screw down the vent caps on the cells snugly. Moisten a bit of clean rag with water (it need not be distilled), and wipe off the entire surface of the battery, including posts and connector bars. When it dries, the result will be a spick and span battery, free from gum and corrosion. Repeat the process whenever charging has covered it with more spray.

It will then be unnecessary to use grease or vaseline on the terminals, since there will be no corrosion.

Do not use soda or ammonia. If either leaks into the cells, the price will be that of a new battery. Be sure to use a damp rag. A dry one will not absorb the acid properly.

A Note on Filament Ballasts

THE advent of A type power tubes (112A and 171A) has introduced a little complication which must be taken into account by set users who purchase them.

These tubes consume only a quarter ampere of filament current, whereas the tubes they replace (the 112 and 171) consume a half ampere. This means that when the A type is substituted for the latter, there must be a corresponding change in the filament ballast employed.

With the 112 and 171 a half-ampere ballast is used. But should this be left in the circuit to control a quarter-ampere tube, it will permit the voltage reaching the filament to be excessive, thus shortening the life of the tube materially.

It is therefore important that a quarter-ampere ballast, like those controlling the 201A tubes, be substituted at the time tubes are substituted. If a single ballast is used to control all the audio frequency tubes, as is often the case, this should be replaced by a one-quarter ampere smaller in capacity.

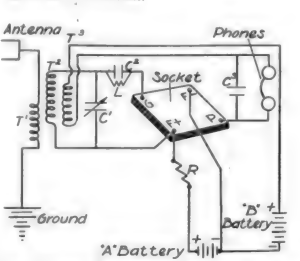
A Simple One-Tube Receiver

THE one-tube receiver shown in the accompanying diagram is inexpensive, simple to construct, selective, and a good distance getter.

In addition to the parts indicated, there will be required a panel 7 by 10, a baseboard 6 by 9, 7 binding posts, mounting brackets, hookup wire, and the tube.

Drill the panel so the tuner will come at the left and the variable condenser at the right along a center line, with a rheostat between and below. Place the binding posts along the rear edge of the baseboard and the socket in the center. Mount the three panel instruments; fasten the panel to the baseboard, and connect.

A 199 tube gives good results. The A battery for it should consist of three dry cells in series, and the B battery a 45-volt. Grid leaks of from 3 to 6 megohms should be tried, and the one used which gives smoothest oscillation.



This diagram illustrates the "hook-up" of an easily made, inexpensive one-tube receiver.

RADIO POWER *from the* FARM LIGHT PLANT

Some simple methods of connecting radio batteries with the farm light plant to afford a convenient and steady flow of power for the set are explained in this article.

DURING the past year more and more radio receivers in cities and towns have had their power supplied from the alternating current light lines. On farms where such current is available the same change has also taken place. But on many other farms electricity is generated by small direct current plants, and here the standard a. c. sets are, of course, useless. However, such farm plants can be made to supply part or all of the power for operating a battery type receiver, at small trouble or expense and with a considerable gain in convenience.

Farm light plants are divided into two general types, 32- and 110-volt. The 32-volt consists of a storage battery of 16 cells charged by a generator, and this battery forms an admirable source of A or filament power for the radio set.

Two methods of utilizing it can be followed. In the first (Figure 1) a resistance unit is connected in series between the lighting circuit and the receiver's A posts, to reduce the 32-volt supply to the 6 required by the set. Such resistance units are being made by several manufacturers, and all that is required in addition is a suitable plug and cord for connecting to an outlet on the house circuit.

Second Method Saves Current

However, the same result can be obtained, with a saving in current, by following the method shown in Figure 2. Two wires are run from the A posts of the receiver to the plant battery, and connection made as shown to any group of three cells by means of clips.

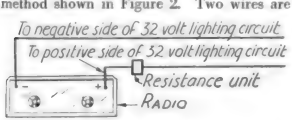


Figure 1

Standard No. 14 rubber-covered wire should be used, and if the distance from

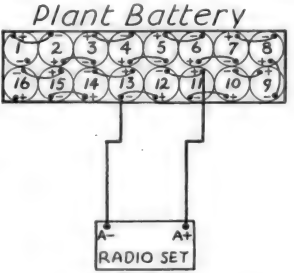


Figure 2

the set to the plant is more than 50 or 60 feet, No. 12 or even 10 will be better, because of the voltage drop. The wire can be simply tacked up with staples as in bell circuits, since the voltage carried is low.

It is important that the clips be shifted from time to time, to place a different group of three cells in the radio current. For example, cells 2, 3, and 4 may be used for a while, then 6, 7, 8, then 9, 10, and 11, etc., until all have been used in rotation, when the process can be repeated from the beginning. The purpose of this is to distribute the drain of the radio over the entire battery, instead of confining it to three cells; otherwise, they would in time be run down because of more current being drawn

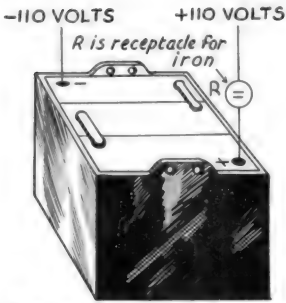


Figure 3

from them than the remainder. The change should be made every two or three weeks, and it would also be well to take hydrometer readings to be sure that the cells used "come up" with the rest.

B and A Power Supplied

When a receiver so supplied is used while the plant battery is being charged, a hum will generally be noticed. But this is not a serious objection since charging is usually done during the day.

The 110-volt farm plants are divided into two types: those employing simply a generator (such as the various automatic systems), and those employing a storage battery charged by a generator, either as the main or stand-by source of power.

The former will supply B power to the radio receiver by means of a standard d. c. B unit. The simplest form of A power in this case is the usual storage battery which can be charged conveniently by the method shown in Figure 3.

The resistance, R, can be the family flat-iron, which passes about 5 amperes. Charging can be carried on while the plant is being run for lights during the evening, if it is not desired to run it through the day for charging only, though, of course, the receiver cannot be used while the battery is being charged.

If the 110-volt plant is one of the comparatively few using a battery, the arrangement shown in figure 4 will supply the receiver with B power at very small cost and quite satisfactorily. Wires should be run from the set to the plant as in the case of the 32-volt system for A supply, and connections made to the proper cells by means of clips.

Each cell normally delivers 2 volts. So the wire from the 45-volt B post should be connected to cell No. 23, the wire from the 90-volt B post to cell No. 45, and the wire from the power tube B supply to the full battery.

Recharging Is Simple

It is not necessary to change the clips here as in the case of A supply from the battery, since the current drawn is too small to make any appreciable difference in the charge. However, here again the set cannot be used while the battery is being charged, due to the hum caused by the commutator of the generator.

For filament power from a 110-volt battery plant, the usual storage A is simplest and most satisfactory. It can be charged while the plant battery is being charged by the arrangement shown in Figure 5. The radio battery is connected as indicated, in the generator bus, after the switch has been opened (and be sure the switch is opened before the battery is connected, else a short

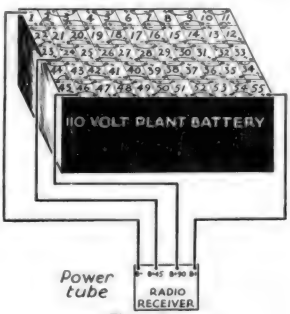


Figure 4

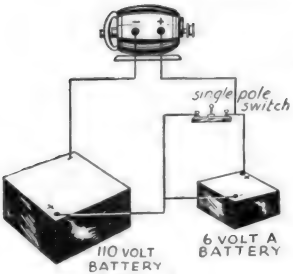


Figure 5

circuit will result). This connects the radio battery in series with the plant battery, permitting the generator to charge both. When it has been charged it can be disconnected and the switch closed once more.

While charging both batteries it may be necessary to turn up the field rheostat on the generator to hold the amperage at normal. But this is not difficult.

If these simple directions are followed the farm light plant will be found to add greatly to the convenient operation of the radio set. The diagrams show clearly the method of making connections, and if they are carefully followed the task of tapping the farm power plant for current should be a simple one, resulting in increased efficiency of the radio set.

"C" Voltages Important

SIMPLY because a set can be made to "perk" without C batteries, some radio fans (and not only the inexperienced) make the mistake of assuming that the grid bias voltage is a useless frill for amplifier tubes. It is a mistake and one whose price is paid not only in inferior operation, but in dollars and cents.

A set will work—after a fashion—without C batteries. But the tone quality will be decidedly poor, and if a milliameter is inserted in the B supply circuit it will show a very high consumption of plate current. So it can be seen that the purpose of C batteries is to minimize distortion due to the amplifier tubes and hold the B drain to the proper figure, both quite desirable in modern receivers.

The ear will detect the difference in tone quality instantly when the proper grid bias voltages are used. But it requires measurements to see the saving in plate current secured. Tests have shown that the use of correct C batteries reduces the B consumption 50% to 90%.

If batteries are being used this, of course, means longer life for them and a direct money saving. If a B eliminator is being used this saving also applies to almost as great an extent. Without the proper C voltages the B unit will be overloaded, which will shorten its life materially besides increasing the hum in the loudspeaker.

Recommended Voltages Listed

Accordingly, the C voltages given in tube specification sheets should be followed with the same care as A and B voltages. This should be done in the case of all amplifier tubes, and particularly power tubes, where the plate consumption is greatest and the power is delivered direct to the loudspeaker and hence the proper grid bias is most important.

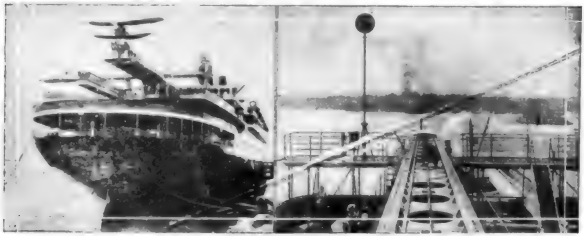
It will be noted in reading tube specification sheets that the C voltage varies with the B voltage. This should be kept in mind when the B voltage is changed for any reason.

Also, if batteries are being used to supply the C potential, they should be tested occasionally. Their life is virtually as long as if they were standing idle. But deterioration sometimes takes place abruptly, which may cause trouble.

Following are the C voltages recommended by manufacturers for the more popular types of amplifier tubes when used at usual B voltages:

Tube	B Voltage	C Voltage
201A	90	4.5
112A	135	9
171A	135	27
171A	180	40.5
199	90	4.5
120	135	22.5

Plane Catapult Saves 18 Hours Time



—International Newsreel

Stern of the Ile de France with its plane-launching catapult is shown above. The cable which launches the plane can be seen in the picture at the right.

PASSENGERS aboard the *Ile de France*, luxurious new passenger steamer plying between New York and Cherbourg, can now speed up their ocean journey by hopping off the ship in an airplane when a few hundred miles off the French coast, the plane carrying them directly to Paris. This is made possible by a 60-ton catapult installed on the deck of the steamer, which launches an amphibian plane.

On a recent test flight, the airplane left the ship 450 miles at sea and flew to New York with a mail cargo, clipping 18 hours from the regular sailing time of the vessel. Perishable express matter and other types of cargo requiring fast delivery will be carried by the airplane.

—International Newsreel

A crime-detecting movie camera is hidden inside this automatic telephone box.

BANKS PROTECTED BY CAMERA

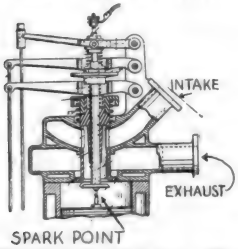
AN AUTOMATIC movie camera which is expected to play a big part in the detection of criminals has been invented by John E. Seebold of Los Angeles. The camera is hidden inside an automatic telephone box, where it is invisible and silent. The device will be installed in banks and other places likely to be visited by criminals, and in case of robbery the cashier can set the hidden camera going by pressing a button, getting a clear action picture of the holdup men. Pictures have been taken at a distance of 85 feet, the subjects being unaware of the camera's presence.

An ingenious chock device which drops under the rear wheels of an automobile and brings it to an almost instant stop has been designed. The chocks, or shoes, weigh about eight pounds and are fastened to the chassis.

USEFUL INVENTIONS

How often have you said, "Wish I'd thought of that!" Here are a few unusually interesting devices upon which the U. S. Patent Office has recently granted exclusive ownership. It is possible they will find public favor and reap fortunes.

SELF COOLING VALVE

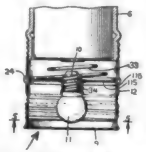


When the first valve-in-head engine was produced the automotive industry considered it a huge joke. Today it is to be found in such overwhelmingly successful cars as the Buick, Chevrolet, Stutz, Oakland, and others. Proved by years of usage, it is one of the most popular internal combustion engine designs. Here is an improvement in which the cold incoming charge passes through the hollow, hot exhaust valve, cooling it and adding greatly to length of valve life.

TELEVISION TOY

Many of the most profitable inventions are those which can be sold to children, who appreciate novelty more than grown-ups do. Here is a toy which shows a group of pictures, any one of which can be adapted by the child's imagination to be the exact image of the person to whom he is talking.

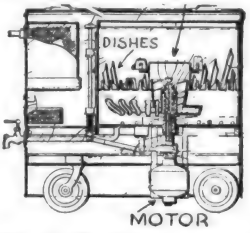
SPARE LIGHT BULB



Space at bottom of flashlight for carrying bulb.

The small bulbs in the ordinary flashlight are subjected to the most severe service to which light filaments can be put. Constant flashing, severe racking and jolting combine to make the life of flashlight lamps very short. Campers and autoists will appreciate the cleverness of the simple enlarged bottom cap in which a spare bulb can be carried, safely shielded from shock.

FIRST AID TO HOUSEWIVES



What housewife hasn't asked for a mechanical dishwasher? Here's one that can be placed in any kitchen, plugged to the light socket and connected to the kitchen sink. It will promptly wash and dry the dishes for the largest family Thanksgiving dinner ever held.

Build this PUSHMOBILE *from* SPARE PARTS

by T. S. ASGAARD

Pushmobile racing is great sport when you own as trim a little racer as the one shown on the bottom of this page. The blueprint shows how to construct such a sturdy pushmobile from parts to be found in almost any basement.

Detail of the tie-up between steering rope and front axle is shown in this picture.

THIS pushmobile is made from old parts which can be salvaged from almost any junk heap. It is the type seen in the late fall when the pushmobile season is on and the newspapers are conducting "Derbies." It should take not over a morning's fun to build and while very simple, it is strong and will last a long time. It is very easy to steer, and will stand a good chance of winning any pushmobile race.

If it is desired, an old Ford starter motor may be used in conjunction with a storage battery to make it an electric auto. With a starter mounted by belt and pulley to the rear wheel, the little car will have a range of about a mile and a half before the battery will need recharging.

A piece of two by four exactly 48 inches long is used for the frame. This is bored for the steering pivot bolt as shown in the diagram. Radiator and dashboard 4 inches wide and about 20 inches high are cut to suitable and pleasing shape, and mounted so the broomstck steering control can be installed.

The axles are mounted to the cross pillow blocks and are stapled on with the kind of heavy barn staples found in any hardware store. Then the pillow blocks and the wheels are mounted on the frame, the steering bolt slipped through with the washers in the place indicated, and the steering rope hooked up.

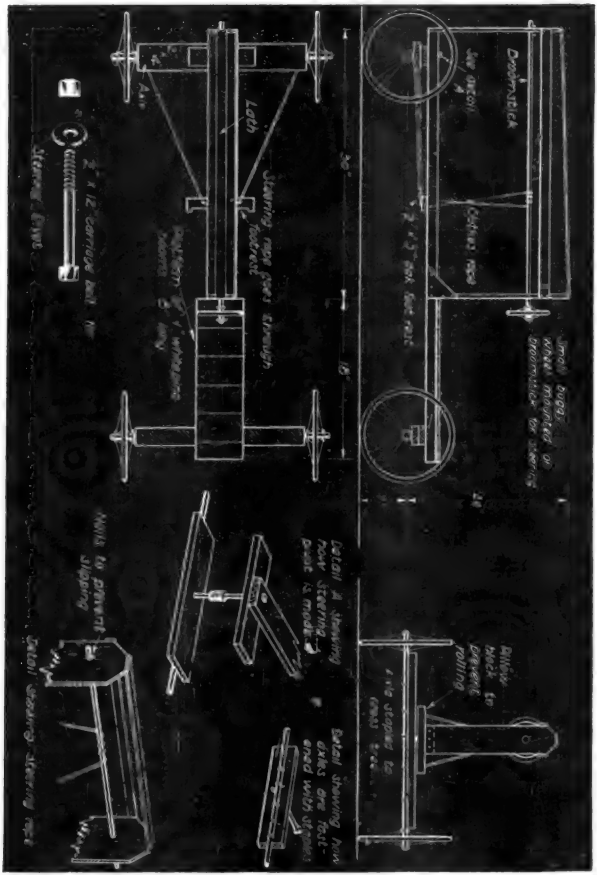
The small cross boards for the seat are made of heavy box lumber and are fastened with ordinary 8 penny nails clinched.

The addition of a steering wheel makes this extremely simple pushmobile complete.

In racing one of these cars there is no particular need to exercise care except for the steering, which must be accurate. Given a man to run behind the car at good speed, and given a driver who will keep his steering line taut so there will be no tendency to weave, the pushmobile shown here will stand a very good chance of winning any race.

Should an electric drive be installed, a piece of round leather belting will be needed, and an idler pulley hung on a lever to serve as a clutch, because the starter motor, operating on a bare 6 volts, will not be powerful enough to start the car unless a reduction ratio of about 60 to 1 is employed.

Here's the completed pushmobile, ready to "show its stuff" as a racer.


Broomstick
Small bugs, wheel mounted or broomstick for steering
Lath
Steering rope goes through footrest
Detail A showing how steering post is made
Detail showing how axles are fast-ened with stones
Nails to prevent slipping
Detail showing steering rope

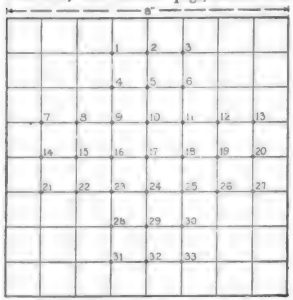
Conducted by **A. NEELY HALL**

For twenty-five years A. Neely Hall has been getting right next to the hearts of boys throughout the country with his authoritative articles on how to make things. Each month this department will contain diagrams and descriptions of articles which can be made in your own workshop at small expense—articles which are not only fun to put together, but which are designed for practical uses.

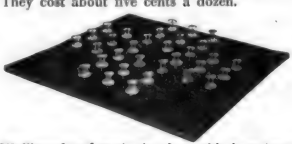
Solitaire Board

EVERY member of the family will enjoy this solitaire board, but every one will not succeed in solving the problem of jumping the pegs until only one remains. There are seven ways of doing this, and after I tell you how to prepare the board, I shall show you the jumps to make in their correct order.

Solitaire boards can be made of wood or wallboard, and wooden pegs, marbles or pins can be used for pegs. The photograph shows an excellent board made of a piece of wallboard 8 inches square, with glass headed push-pins for pegs. The little push-pins cost twenty cents a dozen, or fifty-five cents for a set of thirty-three, the number required for the board. Brass-headed tacks may be substituted for the push-pins. They cost about five cents a dozen.



Arrangement of figures on the board is shown in this diagram.



Wallboard and push-pins form this ingenious puzzle board.

To locate the holes in the piece of wallboard, mark off eight 1-inch divisions along each edge, and connect opposite points with straight lines, as shown in the diagram. Then with one of the pins punch a hole at each of the thirty-three line intersections, as the diagram shows. Stain the wallboard, or give it several coats of lacquer or enamel. It is not necessary to number the holes, as in the diagram. They are shown numbered as a key to the given solutions.

How to Solve the Puzzle

Here is the problem: Jump one peg over another, jumping lengthwise and crosswise of the board, and removing each peg jumped over, until only one peg remains.

Solution No 1. Stick pegs in all holes except No. 1. Then jump the pegs in the following order:

9 to 1, 7 to 9, 10 to 8, 21 to 7, 7 to 9, 22 to 8, 8 to 10, 6 to 4, 1 to 9, 18 to 6, 3 to 11, 20 to 18, 18 to 6, 30 to 18, 27 to 25, 24 to 26, 28 to 30, 33 to 25, 18 to 30, 31 to 33, 33 to 25, 26 to 24, 16 to 18, 23 to 25, 25 to 11, 6 to 18, 13 to 11, 18 to 6, 9 to 11, 11 to 3, 3 to 1.

Solution No. 2. Stick pegs in all holes except No. 4. Then jump the pegs in the following order:

16 to 4, 1 to 9, 14 to 16, 16 to 4, 3 to 1, 1 to 9, 6 to 4, 4 to 16, 7 to 9, 18 to 6, 13 to 11, 6 to 18, 26 to 12, 27 to 13, 13 to 11, 24 to 26, 33 to 25, 26 to 24, 28 to 30, 31 to 33, 33 to 25, 16 to 28, 18 to 16, 9 to 23, 28 to 16, 25 to 23, 16 to 28, 21 to 23, 28 to 16, 11 to 9, 16 to 4.

Solution No. 3. Stick pegs in all holes except No. 10. Then jump the pegs in the following order:

12 to 10, 26 to 12, 13 to 11, 27 to 13, 10 to 12, 13 to 11, 24 to 26, 33 to 25, 26 to 24, 23 to 25, 32 to 24, 31 to 23, 16 to 28, 21 to 23, 4 to 16, 7 to 9, 16 to 4, 1 to 9, 28 to 16, 16 to 4, 14 to 16, 25 to 23, 23 to 9, 11 to 25, 4 to 16, 2 to 10, 3 to 11, 10 to 12, 16 to 18, 25 to 11, 12 to 10.

Solution No. 4. Stick the pegs in all holes except No. 14. Then jump the pegs in the following order:

16 to 14, 4 to 16, 17 to 15, 6 to 4, 29 to 17, 17 to 5, 2 to 10, 18 to 6, 3 to 11, 20 to 18, 18 to 6, 13 to 11, 6 to 18, 26 to 24, 33 to 25, 24 to 26, 27 to 25, 31 to 33, 18 to 30, 33 to 25, 22 to 24, 25 to 23, 7 to 9, 10 to 8, 1 to 9, 28 to 16, 16 to 4, 21 to 7, 7 to 9, 4 to 16, 16 to 14.

Solution No. 5. Stick the pegs in all holes except No. 17. Then jump the pegs in the following order:

19 to 17, 6 to 18, 13 to 11, 18 to 6, 3 to 11, 10 to 12, 1 to 3, 4 to 6, 3 to 11, 12 to 10, 30 to 18, 17 to 19, 20 to 18, 27 to 25, 18 to 30, 16 to 4, 7 to 9, 10 to 8, 21 to 7, 7 to 9, 4 to 16, 15 to 17, 23 to 25, 32 to 24, 24 to 26, 33 to 25, 26 to 24, 17 to 29, 31 to 23, 22 to 24, 29 to 17.

Solution No. 6. Stick the pegs in all holes except No. 23. Then jump the pegs in the following order:

25 to 23, 11 to 25, 10 to 24, 30 to 18, 23 to 25, 18 to 30, 9 to 23, 13 to 11, 6 to 18, 27 to 13, 26 to 12, 13 to 11, 18 to 6, 1 to 9, 8 to 10, 3 to 1, 6 to 4, 1 to 9, 10 to 8, 22 to 24, 8 to 22, 21 to 23, 7 to 21, 24 to 22, 21 to 23, 28 to 16, 30 to 28, 31 to 23, 16 to 28, 33 to 31, 31 to 23.

Solution No. 7. Stick the pegs in all holes except No. 29. Then jump the pegs in the following order:

17 to 29, 26 to 24, 33 to 25, 31 to 33, 18 to 30, 33 to 25, 6 to 18, 13 to 11, 27 to 13, 10 to 12, 13 to 11, 8 to 10, 1 to 9, 3 to 1, 16 to 4, 1 to 9, 28 to 16, 21 to 23, 7 to 21, 24 to 22, 21 to 23, 16 to 28, 28 to 30, 18 to 6, 6 to 4, 4 to 16, 30 to 18, 15 to 17, 10 to 24, 19 to 17, 17 to 29.

Boat Model *Easily* Made

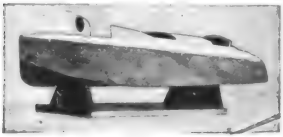
By JOHN MURRAY

USUALLY, the first step in making a model boat is to glue together layers of wood in order that the edges may be whittled at the same time. This is known as the "bread and butter" method and is a wasteful system.

A new method that calls for only four pieces of wood and partly eliminates the danger of splitting wood saves much time in model building.

This boat is made from four pieces of wood. Mounting the model permits the entire boat design to be studied.

The pieces should be of standard lumber such as white pine, which does not require the usual planing to size necessary in the "bread and butter" type of construction. A piece of ordinary white pine two-by-four, some heavy cardboard and plastic wood, are all that is needed for material for a small model.



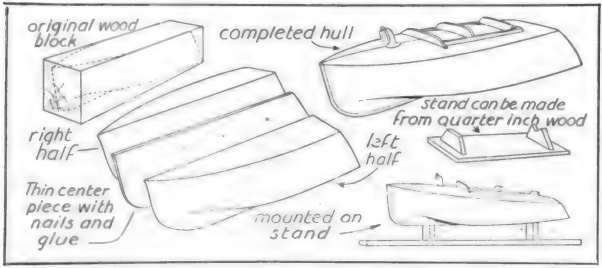
One side should be whittled first, then the counterpart on the opposite side. These halves are whittled to the "bearding line," which, as shown in the illustration, is the line where the planking leaves the keel in full size hulls.

The profile, or outside keel line (see illustrations) is made from heavy cardboard. It is even better to use a thin piece of soft white pine planed down to the scale thickness of the actual keel. This profile is glued and nailed to both halves of the hull.

Decks can be cut and nailed to the hull. Coamings and trim may be made of cardboard. The whole boat should be enameled.

Fittings such as shown on the 9-inch model of the 13-foot hydroplane, "Bumble Bee" (see illustration), can be made from molds of plaster of Paris into which lead may be poured after the plaster has been thoroughly dried to prevent formation of blowholes in the casting.

This method of building a boat is recommended to those who desire to construct a small model in a short time.



Knot-Tying Made Easy

IT IS hard to learn many of the knots from even a clever teacher, and it is difficult and quite uninteresting to repeatedly look at them in a book. Here is a little scheme to aid in learning.

Procure a package of the fine wire cotton-covered smoking-pipe cleaners. Take the book of illustrations of knots, and out of one or more cleaners, carefully bend the form of the particular knot you wish to learn. Be sure the knot is correctly formed and drawn. As you practice tying the knot

you have a real one before you to look at and study

Picnic Scraps *Make* Water Wheel

CHILDREN who become restless when on a picnic can easily be amused with a simply constructed paddle wheel. All the equipment necessary for constructing the wheel is usually found in the lunch kit.

Tin is inserted in split twig.

Tin is bent in paddle-wheel shape and ends of twig put in pop bottles.

Take the covers of two sardine cans and bend them back and forth until four rectangular pieces of tin are obtained. A flat tobacco tin or other can may be used if sardine cans are not available. Select a branch of green wood about one-half inch in diameter and split it down the center for about three-quarters of its length.

Completed paddle wheel is operated by current of stream.

Into the split stick thrust the ends of the four pieces of tin, two on one side and two on the other. Bind the split with twine on both sides near the tin. Now the tin ends can be bent into cup-like shape to react to the water pressure.

Take two pop bottles and insert the ends of the stick in their necks. Place the pop bottles on each side of a small stream, allowing the tin to project down into the water. The force of the current will operate the paddle wheel.

Big New Field *for* Engineers

Last year forty-four students were taking the regular aeronautical engineering course at Massachusetts Institute of Technology, more popularly known as "Boston Tech." This number, according to statistics compiled by the Guggenheim Fund, comprised forty-six per cent of the number of students working for aeronautical engineering degrees in the United States.

Of the above men, all but four were placed in their chosen profession before graduation. As compared with the opportunities in other lines of engineering, the field of aeronautics is greatly undersupplied with skilled men with technical training. Civil and other branches of engineering have long been overcrowded. This is not true of aeronautics.

Tubular Railway

London engineers propose to construct a high speed tubular railway across the river Tyne at an estimated cost of £250,000. The advantage claimed for this novel type of railway is that passengers can be carried at a high rate of speed without danger.

BRITISH APPRENTICES GET THOROUGH TRAINING

The British system of training young engineers presents striking differences to the observer accustomed to American practices. Students of the engineering trades are classed as "apprentices" and "learners." The apprentices undergo a definite period of training and receive a wide range of instruction intended to fit them for their professions. The "learners" do not follow prescribed courses, but on showing aptitude they usually graduate into the apprentice class. Nearly 100,000 apprentices and learners are engaged in the engineering trades of England.

Join the Modern Mechanics Model Airplane Contest

A handsome engraved trophy cup and a cash prize will go to the amateur flier whose model airplane wins the first Modern Mechanics Model Building Contest. Study the rules below and send in your entry.

WIND up your props and get in on the Modern Mechanics Model Airplane contest, you model builders! The Editors have put up a beautiful, hand-engraved silver trophy cup and cash prizes for the amateur aviators whose flying models win this first competition in a series of Model Building Contests.

Each month MODERN MECHANICS Magazine will sponsor a model building contest, the subject to be announced in time for readers in all parts of the country to compete. The rules for the first contest, on model airplanes, are given below.

1. The Model Airplane Contest models must be of the "R. O. G." (Rise Off Ground) type, driven by rubber band motors. There is no other restriction as to size or type.

2. Awards will be made on the basis of workmanship, ingenuity, and flying ability of the models. The best all-around plane, judged by appearance, soundness of design, craft displayed in adapting the working materials, and action in flight will be judged winners, and it must be understood that this is not a contest for long distance flying models.

3. Decision of the judges, Major H. H. Arnold, and Pilot Gene Shank, will be absolute and final.

4. In case of a tie a duplicate cup and duplicate prizes will be awarded tying contestants.

5. The right is reserved to publish photographs and working drawings of the winning models, in MODERN MECHANICS Magazine.

6. Models must be securely wrapped, boxed, or crated, and sent with carrying charges prepaid to Model Airplane Contest, Modern Mechanics, Robbinsdale, Minn. This magazine assumes no liability for possible damage of models incurred in transit, but will observe every precaution in handling submitted models. Entries received without return postage will be held thirty days after close of contest, pending receipt of return postage.

7. It is not necessary to be a subscriber to MODERN MECHANICS in order to compete. Copies of this magazine are available at schools and public libraries.

8. The contest is open to anyone except employees of Fawcett Publications, Inc., or their families.

9. Contest closes December 1, 1928, and no models received after that date will be considered.

The judges will have the models flown by

Model Plane Prizes

In addition to the special trophy cup, which will grace the den of the fortunate winner, a cash prize of $25 will be awarded. Here is a complete list of the pries:

First: Trophy cup and $25.
Second: Ten dollars.
Third, Fourth and Fifth prizes: $5 each.

Don't spoil your chance to win by carelessness in shipping your model. Pack it securely and address it prepaid to Modern Mechanics, Robbinsdale, Minnesota.

non-prejudiced assistants in determining the winners. Bear in mind that since models will vary considerably in size, the distance they fly will not be a deciding factor.

Don't hesitate to send in your model because it may be of small dimensions. If it is well built and graceful in flight it will stand an excellent chance of winning the cup for you.

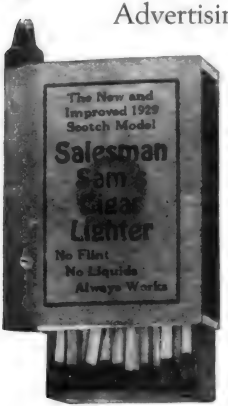
Announcement of the winners of the trophy and cash prizes will be made as soon as possible after the close of the contest, and staff artists will also prepare drawings and photos of the winner to be published in this magazine.

Here's the silver cup which goes with the first prize of $25. The winner's name will be engraved on the trophy.

MODEL BOAT BUILDING CONTEST NEXT MONTH

A COMPETITION for a silver trophy and cash prizes for boat models will be announced in the next, the December issue, of Modern Mechanics Magazine. Watch for it! At the same time details of the contest are published, a complete set of plans for building a small steam-propelled boat that will run under its own power will appear. In the meantime, be sure to enter your model airplanes in the contest announced on this page.

Advertising Novelty Wins Many Smiles



A CIGAR lighter that uses no flints, no liquids, and always works!

Always on the alert for new stunts and novelty, advertising men may welcome this device contrived by the staff of Modern Mechanics Magazine, which is an attention getter as well as the source of considerable amusement.

It's called the Scotch Model, for it certainly involves the minimum of expense. The material used in each lighter costs about three cents; a half cent for the matches, a cent for the candle, and the balance laid to the cost of printing the wrapper.

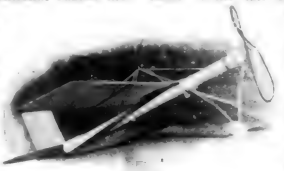
Ordinary brown manila wrapping paper is the best stock to use for the printed matter, which can carry a suitable advertisement in addition to the operating instructions. A small candle, preferably colored, and an ordinary box of safety matches complete the device, as shown in the illustration.

The candle should be placed close to the match box and the correct size of paper measured. Printers' wrapping paste is best for binding.

Making a Paper Tube Plane

By T. S. ASGAARD

THE model airplane shown in the photo is built with an old mailing tube for a fuselage, wood buttons for landing wheels and has a conventional rubber motor. It weighs less than 3 ounces and can fly 200 feet.

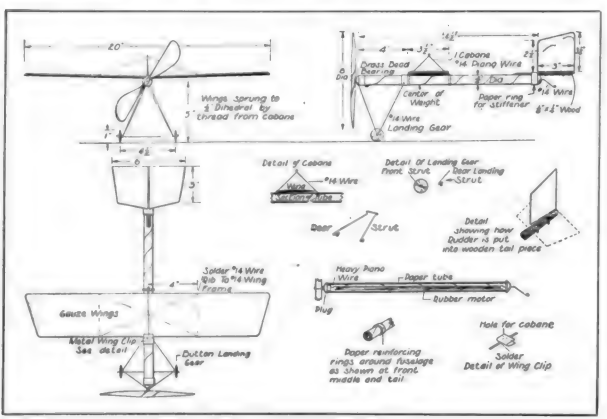


A mailing tube about three quarters of an inch in diameter is pared down until there is but a very little of the shell left. This is then given a good soaking in shellac. When the shellac has dried a wrapping of heavy brown paper is put on with the spiral running in the opposite direction. Another coat of shellac is applied and when this is dry, the fuselage is completed.

Then the wooden plugs which form the motor anchorages are built. These can be whittled, or may simply be pearl buttons with the propeller bead bearing as shown in the drawing. The No. 14 piano wire hook in the tail end is run through as shown.

The landing gear is made of big buttons. These may be filled out for a streamlike effect with plaster of paris, which is very light and porous.

The undercarriage is made of No. 14 piano wire. It can be purchased at any radio shop or music store in the form of bass guitar strings. It is hard to bend and will have to be hammered into shape, or held in a flame at the points where it is to be bent. A model having this landing gear will take a great deal of punishment.



The wings are also made of piano wire, soldered with common household radio solder at the ribs. The wing covering should be of the lightest obtainable close woven gauze. This is delicately sewed or "basted" to the frame. This must be stretched as tightly as possible without springing the wing frame.

Then, when the wing and tail surfaces are covered, a solution of one part of "New Skin" to three parts of acetone, is brushed onto the gauze with a fine brush. When dry it will act like real airplane "dope," tightening the fabric.

The propeller is best made of a fiber blank boiled so it can be bent to pitch. Such a propeller is more nearly shock-proof than spruce. The propeller for this model is 8 inches in diameter and should be of such pitch that the face of a 45-degree triangle will face the blade one inch from the hub.

The motor is ⅛ by ⅛-inch flat rubber of about twenty feet in length, tied in a knot at the ends and looped about the hooks with enough tension to keep the retaining hooked buttons against the fuselage. The tail pieces are mounted as is the wing, as per the drawing.

In flying this model, while it will rise from smooth ground, it is best to hand launch it while first trying it out. The motor should be given no more than a hundred turns at first. The model is held supported in the right hand, and when wind and direction have been figured, the model is released for flight.

The propeller is set spinning before launching to make sure of initial speed.

The model is given a gentle shove straight out in its path of flight, and slightly down.

There will be but few flights needed for attaining balance. The wing is moved forward or backward by the thickness of a hair until the right climb is attained. Then the model can be used any time by simply winding the motor.

Real Gas Engine for Model Airplanes

FLYING a 9-foot model airplane for a distance of a mile, this midget engine well earned its title, "mighty atom." It developed sufficient power to climb to an altitude of 200 feet in this distance. It is a two-cycle, three-port air cooled aluminum alloy engine which develops a half horsepower on a weight of only three pounds.

This tiny motor really runs!

Through an aluminum propeller 18 inches in diameter this little engine has driven a 12-foot canoe 6 miles an hour. Attached to a bicycle it has propelled a 140-lb. man at a speed of 10 miles an hour. It has run a boy's pushmobile at a speed of 8 miles per hour.

It is 1½ inches in bore by 1½ inches stroke, 6 inches in height from bottom of base to cylinder head, and but 2½ inches between base supports. The outside diameter of the cylinder is but 2¼ inches.

A suitable size of model plane for this engine would be as follows: a monoplane of nine-foot wing span with the Fokker cantilever type of wing, having a fuselage nine inches square. The elevator and stabilizing unit should be about three to four feet from the trailing edge of the wing, about six inches in chord, and about a foot in span. A good wing section would be the N. A. C. A. No. 6, dimensions of which can be procured from the National Advisory Committee for Aeronautics, Navy Building, Washington, D. C. This wing section, of the thick type, has a constant center of pressure, and once the plane is balanced while at rest it will fly balanced at all angles of lift. The whole model should not weigh over 10 pounds.

Made by Dynamic Mfg. Co., of Chicago, finished parts of this motor are available at low prices, so that a complete engine with carburetor, spark coil, propeller and all equipment can be assembled with wrench and screwdriver.

Windmill Supplies FARM With Light

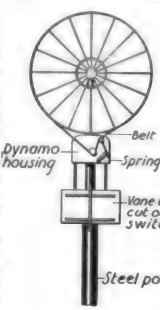
Electricity without cost! A simple wind-operated dynamo supplies all the current needed to light a large farm, at practically no expense.

This wheel turns the force of the wind into electricity.

AN ELECTRIC windmill which supplies a group of farm buildings with an abundance of electric power at practically no operating cost has been constructed by C. E. and W. T. Miller on the Miller-Hills farm in Madison County, Indiana.

The energy of the wind is turned to mechanical power by a wheel twelve feet in diameter which in turn drives a dynamo with a belt running around its rim. A vane hung below in the path of the wind regulates a cut-out switch. This switch automatically connects the charging circuit when the proper amount of wind is blowing. The device practically takes care of itself, requiring almost no attention.

The vanes of the twelve-foot wheel, twenty-four in number, are hinged at one side to each spoke, and are retained by springs. The springs yield when the wind reaches high velocities. This is a safety feature preventing the machine from presenting too much area to the wind in stormy weather. When a wind gale velocity blows, the vanes straighten out, allowing all the wind to rush through, and the wheel stands still.



From the large wheel, the shrouded rim of which is one foot in width, there runs a 3¾-inch belt. This drives the dynamo, charging a set of storage batteries. From these batteries the electrical energy is taken at will.

Centered twenty-one feet above ground, the cone holding the shaft on which the windmill turns, is equipped with an oil reservoir supplying oil to the Timken bearings whereon the shaft runs. The lower part of the column supporting the machine is made of nine-inch gas pipe, eleven feet above the ground, and buried seven feet. It is set in a heavy concrete block. The top portion of the column is a ten foot length of six-inch gas pipe.

The electricity stored in the batteries is sufficient to last two weeks should there be a calm period.

WORLD'S TALLEST STRUCTURE SAFE

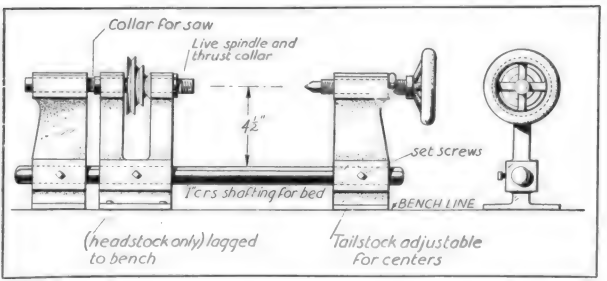
The Eiffel Tower, 1,000 feet high, is as solid today as when it was constructed in 1889, according to a report of engineers making a periodical examination of the structure. Fears that its great weight might cause a settling of the earth beneath it are groundless.

FATIGUE BUILDS BODY WEIGHT

The strain and fatigue of marathon dancing causes an increase rather than a loss of body weight. This is the surprising discovery made by a corps of Pittsburgh physicians studying nine couples who had been dancing steadily for six days. Of the 18 dancers, 10 had gained from 3 to 7 lbs. each, 4 were unchanged, and 4 lost from ½ to 1½ lbs. each.

Building a Bench Lathe

By JOHN MURRAY

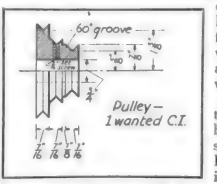


Cast from box-lumber patterns, this ingenious bar bed lathe will saw, plane, sand and turn both wood and metal.

IT IS the writer's hobby to design models of engines, airplanes and small boats. In building them, a great deal of light lathe work is often necessary. To do this metal turning or wood turning an elaborate machine is not necessary, but it does require one which is large enough to do respectable work. The design pictured here is that of a small bench lathe which was built for a model maker's workshop at a cost of a few dollars, which went chiefly for such auxiliaries as live and dead spindles, face plate, etc. It "feels" like a much larger lathe when working with it, and it fills the writer's needs remarkably well.

It is of a size which will handle such things as small steam engine flywheels, up to nine inches in diameter, and is large enough so that an infinite variety of accessories, such as milling attachments, could be used to make it a "man-size" machine.

In conceiving this lathe, an element of play entered. With the story of the desert castaway in mind, the writer determined to see how much of a lathe could be built with nothing but his bare hands and some simple cutting edge, such as a knife. From an adjacent waterfront a piece of floating boxwood was secured, and with a jack-knife the writer set to work.



The wood happened to be the commercial half-inch box lumber which finishes seven-sixteenth inch thick. By looking at the drawing it will be seen how the thicknesses of the castings came to be multiples of this figure, and how extremely simple the pattern for the combined saw-stock and tail stock were. It will also be seen how simple an adaptation of this idea the headstock proved.

The cheeks were not laboriously pegged

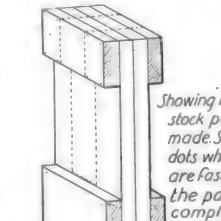
on with square wooden pegs fashioned by weary hours of toil on a desert isle. The romance of building had paled a bit by the time the writer had the patterns whittled, and he used good old shingle nails to fasten them.

When it came to pouring the castings, home methods such as might be found on a desert island scored a technical victory over the "isolated environment." Assuming that if we had been cast away on some isle we would have somehow come into possession of a few old Ford pistons, or could have stolen them from the private carriage of the Cannibal King, and that a bank of clay was available, we would have come out nicely, for we put the rough patterns in a mold of soft, clay-like sand out behind the nearby garage, and using Mother Earth as the drag of our founder's flask, we whittled a three cornered cope for the top half of the mold, which turned out to be very passable.

What would have happened then on a desert isle is a matter of conjecture. Actually we made our own charcoal, and on the garage forge we melted the old Ford piston scrap in a borrowed crucible, from which the castings were poured.

Machining Costs $1.80

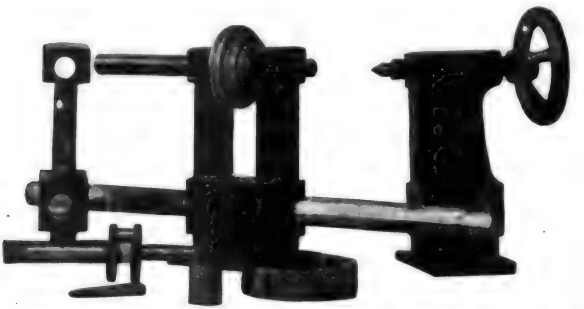
Romance, however, kept on fading out. After casting the molds, we went to a machine shop and got a machinist to cut off the bar-bed in the form of one-inch cold



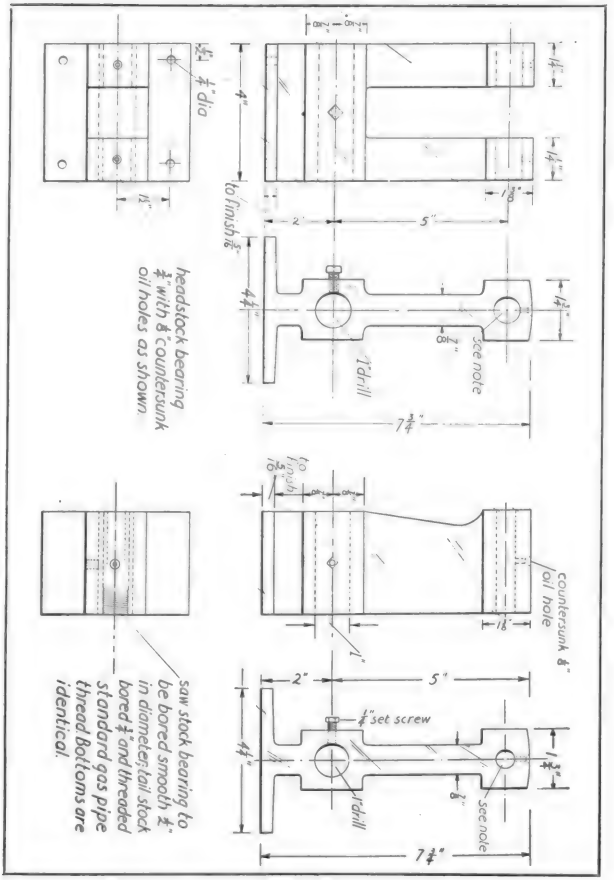
Showing how headstock pattern is made. Saw out on dots when cheeks are fastened, and the pattern is complete.

rolled shafting, and we had him face the castings and bore them as shown in the drawings, with the set screw drillings and the oil holes as shown. The machinist's bill was $1.80.

We found it advisable to get out the bar-



The several parts of the home-made lathe are shown here ready to be assembled.



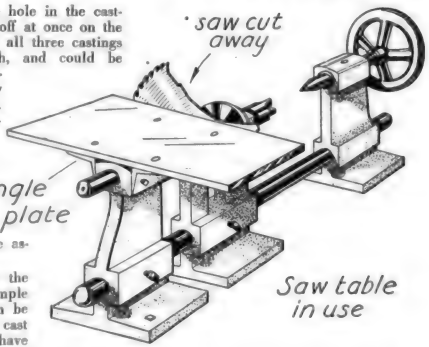
1/4" dia
1/2"
4"
to finish 5/16"
2"
5"
1 3/8"
1 1/4"
1 1/4"
1 3/4"
4 1/4"
7/8"
see note
1" drill
7 3/4"
headstock bearing 3/4" with 1/8" countersunk oil holes as shown.
to finish 5/16"
countersunk 1/8" oil hole
1 1/8"
1"
2"
5"
1/4" set screw
4 1/4"
1 3/4"
7/8"
see note
1" drill
7 3/4"
saw stock bearing to be bored smooth 1/4" in diameter; tail stock bored 3/4" and threaded standard gas pipe thread. Bottoms are identical.

This Lathe is "JACK-OF-ALL-TRADES"

bed first, bore the large hole in the castings, and face them all off at once on the shaft. Then the feet of all three castings were in line and flush, and could be clamped while the bearings and tail and saw stock heads were bored. Also it was found advisable to mill a ¼-inch flat along the bar-bed so that any chewing of the set screws would not affect the accuracy of the line-up or the sliding of the assembly.

The live spindle and the tail spindle were simple enough. The pulley can be turned from almost any cast iron stock, and should have the grooves at 60 degrees, using for drive a common sewing machine belt from a ¼ h. p. motor. The wheel on the dead or tail spindle was taken from an old gate valve and riveted through the shaft.

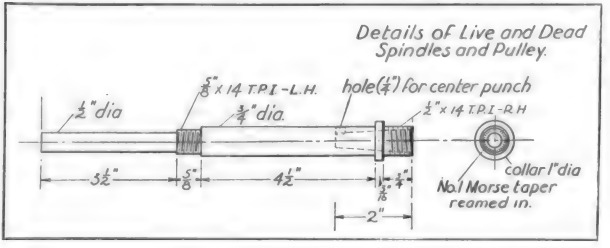
Morse tapers, size No. 1, were reamed into both the live and dead spindles, with holes in the proper place to give leverage on any center which might try to stay put at the wrong time. An old hex locknut was found which fit the tail stock, and in the new capacity locked the dead center just as effectively as the old style clamp. This can be seen from the illustrations.

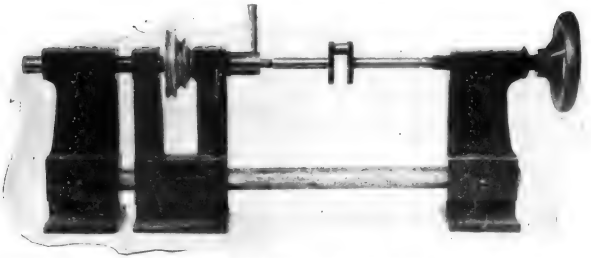


Quarter Horse Motor Used

The tool rests vary greatly in conforming to different work so they were made up as the jobs came along. The saw table was simple, merely a piece of angle iron with a half-inch oak board clamped to it by countersunk flush headed stove bolts.

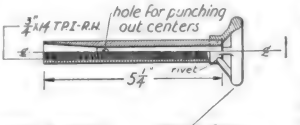
A tool rest can be made from a piece of old railroad rail. The feed will, of course, be through the head of the rail, which can be cut down so that only the web will, when bored, slide along the bar of the lathe.





With the addition of a steady rest for holding the tools the lathe, cast from box-lumber patterns, is ready for work.

Such a rest will be solid enough for any wood turning tool and with the addition of the rest which can be copied from an old lathe such as is found in any garage, one can rig an automatic screw feed feature to this little lathe. In fact, there is nothing that cannot be made and fitted for it once you have mastered the art of making patterns and obtaining casting from your own design.



Dead Spindle – I wanted ¾ gas pipe. Drill & ream for No. 1 Morse taper.

Wheel from old gate valve, cleaned in acid and painted black.

A ¼ h. p. motor is used for power. The great majority of turning comes at a spindle speed of about 1,750 r. p. m.; consequently, there is no need for a counter wheel to slow the lathe down.

Should a counter wheel be needed, a speed ratio of two to one and three to one can be used. This means that the large wheel on the counter shaft, driven by the belt from the motor, shall be three times and two times, respectively, the size of the pulley which is driving the pulley on the headstock of the lathe.

Ordinary round lathe belting can be used for this driving and is cheaply procured at any sewing machine shop.

All screw cutting in the lathe is done with dies in a die stock. Power is furnished by a smooth, hand operated bull-wheel mounted in the place of the saw on the saw arbor. This will do the work as rapidly as is necessary.

One will find the lathe to be all he needs in the average model workshop where more wood-working is done than metal-working. The patterns for the lathe were made in an afternoon and by noon of the next day the machine was ready for use.

All the standard face plates, tool rests and pulleys are standard on No. 1 Morse tapered lathes. They can be used with the added advantage that comes from the adjustable bar-bed and swing.

There are an amazing number of accessories on the market that will fit this lathe and they may be purchased at a reasonable price. Face plates may be obtained for about $2.00. Any variety of tool cutter will cost from $1.00 to $3.00.

Anyone can construct this lathe at a relatively low cost, and with it he will be able to create many objects of value during his spare time.

Pioneers of the

"What good are all these long-distance air flights?" This is the question sometimes asked by practical-minded persons who can see nothing of value in the imagination-stirring flights of past years. Yet these endurance flights are to the aeronautical engineer what the laboratory is to the scientist. The important part played by these pioneers of the air is explained in this article.

"I guess I'll go," said Lindbergh, hopping off for Paris. So began the greatest of the sky sagas!

—Ewing Galloway.

By WESTON FARMER

FIFTY years hence some aeronautic historian will comment on the extraordinary courage and imagination that spurred aviators of the early twentieth century to fly across the Atlantic Ocean in machines as quaint and primitive to him as are the pictures of Magellan's caravels to us.

Alcock and Brown, Lindbergh, Byrd, Chamberlin, Koehl, Fitzmaurice, von Huenefeld, Amelia Earhart—he will marvel at the temerity that made it possible for them to voyage over two thousand miles of water in machines never designed for ocean flying.

And then he will come to the ships of his day, and point out the influences which epochal long distance flights of today had in the design of the ships which will then enable Americans to spend their week ends in Paris, when Berlin and London and Florida will be a Winter Atlantic City for New York, Chicago, and Boston.

We of this day and age will live to see this come to pass, and as we are living in the day which will forecast the aeronautical future of tomorrow, let us pause a bit to consider what these flights mean to aviation, and see what has been accomplished. The list of worthwhile flights is surprisingly long.

In 1919, the American Navy equipped and sponsored the flight of the NC flying boats. The NC-4 under Commander Read made a successful crossing on her own power, flying from Newfoundland to Plymouth, England, by way of the Azores and Portugal, with stops en route.

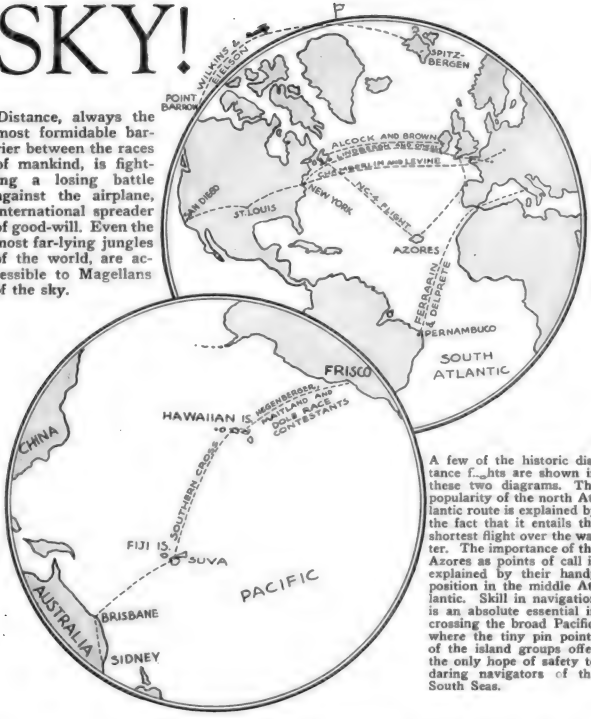
While the United States Navy expedition was under way, Lieutenants Alcock and Brown, two veteran Royal Air Force officers who had seen service at the front, flew a Vickers-Vimy twin-engined biplane to Ireland. They landed 1,960 miles from their point of departure, which was St. Johns, Newfoundland. This was heralded as the greatest feat of aviation, the greatest non-stop flight to that date, and it was a truly remarkable achievement. Considering the limited carrying ability of their plane as against that of present day monoplane designs with air instead of watercooled motors and their much improved design, the feat is an epic of the air—one of the outstanding flights of all time in popular imaginative appeal.

THEN, in 1923, an American hotel owner, Mr. Raymond Orteig, offered a standing reward of $25,000 for a flight calculated to fire public imagination. This flight was to be a hop from New York to Paris.

New York to Paris! The man in the

SKY!

Distance, always the most formidable barrier between the races of mankind, is fighting a losing battle against the airplane, international spreader of good-will. Even the most far-lying jungles of the world, are accessible to Magellans of the sky.



A few of the historic distance flights are shown in these two diagrams. The popularity of the north Atlantic route is explained by the fact that it entails the shortest flight over the water. The importance of the Azores as points of call is explained by their handy position in the middle Atlantic. Skill in navigation is an absolute essential in crossing the broad Pacific, where the tiny pin points of the island groups offer the only hope of safety to daring navigators of the South Seas.

street could grasp that distance—it was familiar to him. So many days of travel by ship, so many hours by train. The distance from Trepassey to Land's End might have been but a day's ride by boat, for all the average men knew. But New York to Paris! That was a flight!

So it was that in 1926 several expeditions were organized. Rene Fonck was chosen to pilot a huge ship built especially for the jump. This cracked up in taking off, and burned the crew. One after the other, the aspirants qualifying for the classic of the air met with disaster. Because of repeated misfortunes, the obstacles were vividly impressed upon the public mind. The challenge that the difficulties flung in the way of birdmen called to the front one of the

Navy's crack fliers, Richard Evelyn Byrd, who was the man chosen by Rodman Wanamaker, long an enthusiast of the project, to pilot a plane he had sponsored. Expedition after expedition was being lined up, and the spring of 1927 saw many ships awaiting fair weather for a takeoff.

Two French fliers, Nungesser (the greatest of all war aces) and a partner, Coli, took off from France in a westerly direction in an effort to beat Byrd and the Bellanca-Levine syndicate. They were never heard from again. In the public mind the hazards of the flight were magnified by their loss.

Still, Byrd carried on preparations. Quarrelling and delay developed in the other camp. The world was watching.

THEN from out a clear sky, a twenty-five year-old back-country lad named Lindbergh electrified the country by crossing the United States in two jumps. In San Diego one day, then St. Louis, on to New York the next he flew, while the press and the nation were focussing attention on the well organized and complex syndicates which were making preparations for the great adventure. Immediately attention was centered upon this unknown lad who dared to undertake, single-handed, a venture which had thwarted the best known aviation experts of all the world, and had claimed many lives.

While others waited and watched for their "break" in the rainy weather, this ex-barnstorming lad stepped to his plane one morning and quietly said, "I guess I'll go."

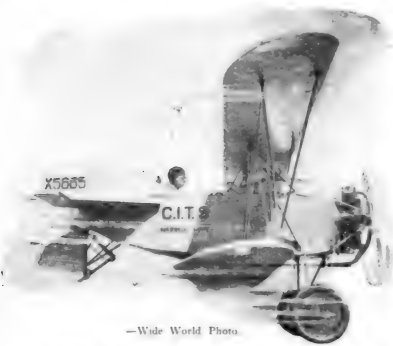
He was off! And thirty-three hours later the dramatic saga of Lindbergh was complete!

What followed is household knowledge. Since then, because of the popularity showered upon trans-Atlantic aspirants, one after another has endeavored to meet the mark set by *The Spirit of St. Louis.*

Why all these flights? What do they accomplish?

The aeronautic historian of tomorrow will point to the great work and development done by all these pioneers. They have risked all in the cause which will one day gather, through their efforts, enough knowledge of conditions out over the ocean, to enable the designers of tomorrow to build ships which will fulfill the prophecy made earlier—knowledge which will one day bring Berlin and London and Florida as close to each other as New York and Atlantic City are now.

The Airplane of the Future?



—Wide World Photo.

This airplane of unusual design will practically fly itself—and that, according to designers, is exactly what may be expected of tomorrow's airplanes. Foremost airplane engineers agree in the prediction that the airplane of the future will not require a skilled pilot—anybody will be able to step into his airplane, decide on his destination by pushing a button, and sit back reading the morning paper until the machine has automatically made the landing and come to a stop.

All of the stability of the plane shown above is inherent in the wings; the tail is used only to steer the craft. The wings can be staggered by means of a wheel control within the cockpit, and once they have been set at the desired angle the airplane rises without the need of a hand at the controls, except for steering.

Tank on Wheels for Garbage Collection

CLOSED tanks mounted on heavy trucks are taking the place of open wagons in collecting garbage in German cities. The picture shows a collection tank designed for use in the city of Braunschweig. Outwardly the tank has the appearance of a large boiler. It is divided into four compartments, each with a separate porthole. The tank rolls over on its side at the will of the driver, running on rollers set along the side of the truck frame. Besides speeding up garbage collection, the new tank eliminates all objectionable odors.

BRITISH INVENTORS ON THE JOB

Fears of pessimists that everything has been invented and that there is nothing left for the ambitious experimenter to contrive are not borne out by the 1927 report of the British Controller-general of Patents. A record was set when 35,469 applications for patents were received.

DEAF HEAR THROUGH HANDS

A modified form of telephone receiver which the patient holds in his hand has been devised for the use of the totally deaf. Speech vibrations are transmitted through the receiver to the skin. After a little practice well known phrases and words are easily recognized through the difference in feel of the vibrations transmitted.

Novel Motorboat

Driven by an outboard motor installed through a well in the hull amidships, this small motorboat will do thirty miles per hour. Any outboard motor of the larger sizes may be used for power.

The boat is thirteen feet long and four and a half feet wide, eighteen inches deep, and weighs two hundred pounds without the motor. All controls are mounted dashboard, and steering is by the con tional motorboat type steering wheel instead of by the usual long tiller.

Instead of being attached to the stern in the conventional manner, the outboard motor which propels this boat is installed through a well in the hull.

Housewives Cheated by Shortweight Measures

A NEW YORK grocer with a mechanical bent recently figured out a method of doctoring his scales to give his customers short measure on their purchases. The

scales were mounted on a wooden box, as shown in the picture, and weighted from the bottom with padlocks, bolts, and other heavy objects. Another example of short measure is shown in the "bushel" basket, cut away to show the false bottom and sides which cheated purchasers out of one quarter of the amount paid for. Government inspectors confiscated these short weight measures and their owners paid heavy fines. A Federal law specifies the sizes of bulk measures, and merchants violating the regulations are harshly dealt with.

—Keystone.

Two reasons why a peck of potatoes doesn't furnish as many meals as the housewife expects, are shown above. The cheating measures were confiscated by government inspectors.

DEAD MAN MEETS WITH COLLEGE BOARD

One of the most unusual wills on record was that of Jeremy Bentham, a wealthy Englishman of the eighteenth century who bequeathed a large sum to University College, London, on condition that his body be preserved and brought out to occupy a place of honor at the meetings of the college staff. His mummified skin was accordingly preserved, stuffed, and clothed with a mask. It is seated in a sedan chair which is carried to the meetings in accordance with the strange request of a man dead for more than a hundred years.

The mummified figure of Jeremy Bentham, dead for a hundred years, presides at staff meetings of a college he endowed. —Keystone.

CHEMISTS RECLAIM ASBESTOS ORE

The original owner of great asbestos mines in Canada refused to believe that the refuse left after he had extracted the long mineral fibers from the ore was of any value. He regarded as useless the enormous dumps of "cotton stone" or rock in which short, silky fibers was still imbedded.

When his business failed and the mines passed into new hands, his successor consulted with chemists and developed a method of crushing the rock to utilize all the ore.

Conducted by MRS. C. M. SULLIVAN

In line with Modern Mechanics Magazine's policy of having all departments conducted by experts, Mrs. C. M. Sullivan has been appointed editor of this department. For several years Mrs. Sullivan has been in charge of the Household Service division of a large New York department store, where her duties require her to pass upon the merits of innumerable devices brought out to lighten the labors of the housewife.

Repainting Antiques

BEFORE the new pyroxylin finishes sold under such trade names as "Duco," "Valspar," etc., can be applied to painted or varnished surfaces, the old protecting paint must be removed. The quick drying pyroxylin paints act as paint removers when used on lead painted surfaces or on varnished surfaces, and unless the original finish is removed, any attempt to apply new color will result in a very messy curdled surface.

To remove varnish or paint, a mixture of alcohol and turpentine should be warmed in a bottle by immersing in hot water, and then applied hot. The remover should be dabbed on with a cotton swab, left to soak through, and then with a dry cloth the finish can be wiped off.

This mixture has the advantage that it can be applied time after time until the wood grain is at the surface and all the old finish is gone. The quick drying finishes then can be applied and a good finish is assured.

Simple Jar Opener

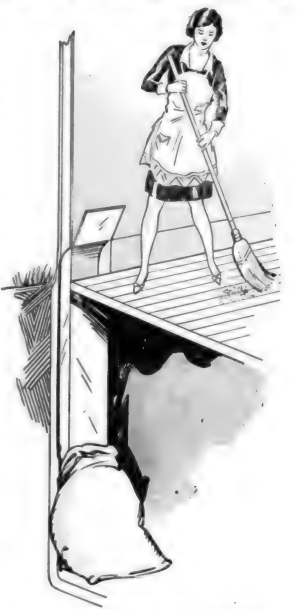
Made from an old trunk strap and a short length of broom handle, this adjustable wrench comes in for much use in the fall fruit season. Any strip of soft leather about a foot in length is suitable for use. One end is punched with three or four small holes fitting over a screw head to allow of adjustment. The other end of the strap is tacked to the wooden handle as diagrammed. With this device hot Mason jars can be sealed tightly with the assurance that the wrench will quickly remove the gasketed tops without resort to the usual methods of immersion in boiling water. The soft leather grips the metal tops securely.

Handy DUST CHUTE *Saves Work*

ONE of the noticeable things about the new homes which architects are designing to meet with modern conditions of living is the increased use of all kinds of labor saving devices. Homes are electrified and fitted with appliances unthought of ten years ago. A recent survey of the amount of time spent in tasks classed under the heading "Household Drudgery" reveals that the modern housewife accomplishes in forty minutes that which took her mother one hundred and twenty minutes. This is all in line with the American creed of efficiency which gives more leisure as a reward for speedier methods of accomplishing work.

One successful small house designer has incorporated a built-in appliance which saves a great deal of time in the disposing of household dust and sweepings. A chute is built in the house at the time it is erected, into which a special aluminum casting is hinged so as to exclude drafts at the floors. This cover is matched in section with the moldboard, hinging up as the dirt gathered is swept down the chute which leads to a sack in the basement.

Such a disposal system is in reality a counterpart of the laundry chute idea.



BREAD FROM SKIM MILK POWDER

The Department of Agriculture has perfected an improved method of drying milk into powder. The dried skim milk is particularly suitable for use in making bread, and is said to greatly improve the nutritive value. Ten pounds of milk left over from butter making is said to make nearly a pound of powder, and it is said that the available supply of skim milk is far greater than is now being used for making powder.

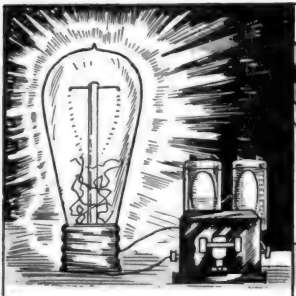
The powder contains 38% of proteins, 50% of lactose or milk sugar, and 8% of valuable salts. Thus the dried milk, used with good flour, increases the food value of bread. It is said that the powder enables the baker to obtain a loaf of 10% larger and about four per cent heavier, of better flavor and more nutritive. The added cost of the powder is balanced by the greater number of loaves per barrel of flour.

MILK BOTTLE BREAKAGE

The Bureau of Dairy Industry recently surveyed ten large milk plants in the Middle West. It was found that the average is 12.77 pounds of broken glass per 1,000 bottles filled. The losses are itemized as follows:

Route breaking and dumping	2.49 lbs. per 1,000
Handling to washing machines	3.01
Breakage in washer	3.47
Breakage at fillers	2.92
Milk storage room and checking out	0.88
Total	12.77

Toys from Discarded Lamp Bulbs

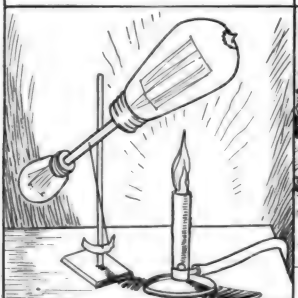


Spectacular Fireworks

Amuse and delight the kiddies by hooking a lamp in which the filament has been broken in circuit with a spark coil. Brilliant, weird, light results.

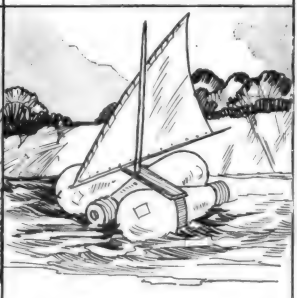
Spouting Fountain

Hold a lamp under the water and break the tip off. A tinkling rush of water will spout into the bulb until the vacuum has been replaced with liquid. If you want a surprise, try this with ginger ale!



Gravity Experiment

To prove that cold air weighs more than warm, heat the air in one of two carefully balanced bulbs from which the tips have been broken. The cold end will sink.



South Sea Sailboat

By binding three bulbs together a craft can be readily improvised after the manner of a catamaran, which will sail well and please the youngsters.

Solving the problem of what to do with old bulbs!

$97 Movie Made in Hollywood Kitchen

By A. L. WOOLDRIDGE
Special Hollywood Correspondent

Stories of millions of dollars spent in producing ten-reel movie features have given the public an idea that only a big company could produce profit-making motion pictures. But Robert Florey, expending $97 produced a picture which is making him wealthy!

IF YOU have $100 or so, plus a few old cigar boxes, a motion picture camera, and a desire to break into the movies—as who hasn't?—you can be your own director and cameraman and produce a motion picture worthy of exhibition in theaters throughout the country. That is, you can if you are as skillful and economical as Robert Florey, who cut his sets from cardboard and cigar boxes and produced in a Hollywood kitchen, at a total cost of $97, a movie which is being shown in United Artists theaters all over America.

Futuristic creations, Florey calls them. "Creations of a genius!" say old studio heads.

Florey, who has been about everything in pictures from wardrobe designer to assistant director and "gag man," has exploded the theory that a "movie" must be made in a million-dollar studio beneath the glare of the Kleigs, while soft music is playing. Rather, he has demonstrated that a marketable production may be filmed most anywhere—in a kitchen where the music of pots and pans is played, or out in the street where tram cars and traffic take roles.

Robert Florey, young Hollywood director, produced a complete motion picture with this camera at a cost of $97.

Hollywood was astonished a few years ago when Josef von Sternberg made "Salvation Hunters" in a studio on Poverty Row at a cost of $4,500. Critics didn't think much of "Salvation Hunters," but it was extensively shown and made money. Robert Florey's pictures now make von Sternberg's $4,500 accomplishment look like nabob extravagance, as neither he nor his associates could afford any such reckless expenditure of money. One hundred "bucks" had to be the limit on the first production because one hundred "bucks" was about all the money he had. Even now, while their offerings are going good, that sum isn't greatly exceeded.

"We didn't have any treasury, any stockholders, any props, any anything except our weekly pay-checks," said Florey at the side of his camera when I called the other day. "And," he added, "some of us didn't even have pay-checks. I had the idea for my first picture and one night in a restaurant I met Slav Vorkapich, the Serbian painter, to whom I confided my plans.

"'Let's buy the short ends of films at the studio,' I suggested, 'and make a picture. Short ends will cost us about 1 cent a foot. New film in rolls costs about 3 cents. I'll cut out sets in miniature—make them from cardboard that comes back with my laundered shirts, and from boxes. Then you paint 'em. When we need big scenes, we'll grab 'em on the streets.'"

The idea hit. Florey and Vorkapich pooled their possessions and went to work. They found they would have to invest fully $3 at a 5-and-10-cent store for three toy trains, four toy automobiles and a boy's mechanical building set. Then there would have to be string, mucilage, a paper of pins and a few other small items.

In Vorkapich's kitchen one night, Florey cut "buildings" with scissors and knife while his companion painted doors, windows, fire escapes and chimneys upon them. It took days to complete the task. Then the "producer" went out in search of actors temporarily out of employment, or rather, "between pictures," as they term it.

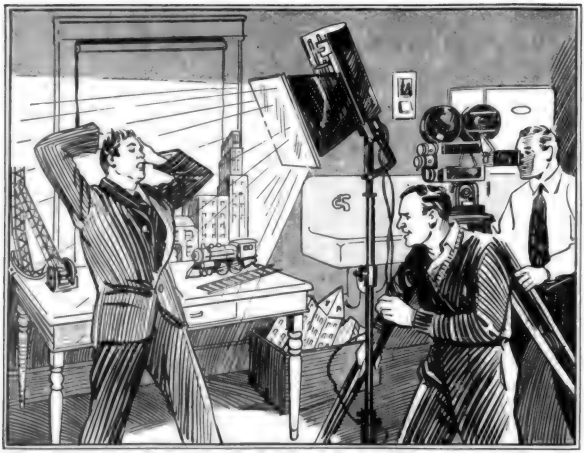
They found Jules Raucort, a Belgian, who years ago was leading man for Pauline Frederick and later the star of several Maurice Tourneur productions. They stumbled upon Voya George, a Serbian whom Vorkapich knew. Both agreed to lend their talents, not for immediate compensation but for "part of the benefits" which might accrue. Adrian March, an "extra" girl, was induced to play the heroine of the picture for similar remuneration. In addition to these, the producers took roles themselves. Gregg Toland, cameraman for Samuel Goldwyn, agreed to photograph the production.

"Twenty scenes an hour," directed Florey. "This is going to be a great picture. One hundred and fifty scenes. Let's go."

"Crazy" Story Makes Hit

Their story, "The Life and Death of a Hollywood Extra," was based on the experiences of an actor seeking employment. On every hand he encountered the sign, "No Casting Today." He moved about in a daze, tired, hungry, revolving in his mind, "No Casting Today! No Casting Today!" A producer valuing him as only one of the thousands of "extras" brands him on the forehead with the number 9,413. He begins

Episodes from the hectic existence of a Hollywood extra are fantastically pictured in Florey's movie. Above are several "shots" of the film, illustrating the futuristic treatment of the story.



Ten-cent toys and cardboard buildings stacked up along the kitchen wall were the only sets used in filming the $97 production "The Life and Death of a Hollywood Extra."

going "blah-blah" and moving his lips like a dummy. The world goes dizzy, buildings whirl round and round, street cars shoot toward heaven. From unexpected places pop out traffic signals "STOP" and "GO." The goofy extra tries to comply with the confusing directions.

He meets a star who "high-hats" him, but finds that the star, too, is going crazy. Then the little heroine becomes demented. Finally, in utter exhaustion and thoroughly disgusted with life, the poor "extra" lies down to die. His spirit leaves its earthly body and turns to look at what has been carrying it around.

Then the extra awakens.

"Crazy!" one exclaims on seeing it.

"Impressionistic!" corrects Florey in mock hauteur.

Just the same, persons laugh uproariously at the exotic, distorted, "looney tale." Virtually every trick of the motion picture camera is incorporated in its making. There are cut-backs, fade-ins, fade-outs, lap dissolves, scenes shown upside down and others revolving.

At a private showing in the home of Charlie Chaplin, there were present Joseph Schenck, Doug and Mary, Camilla Horn, Harry d'Arrast and a few other motion picture people. As the impressionistic creation began to unreel, the audience snickered. Then it guffawed. Presently, in a dignified way, it howled.

"That's good enough for our theaters," exclaimed Mr. Schenck. "I think we could use a half dozen more."

Players Share in Melon

The total expenditure on the production was classified, according to Florey's books, as follows:

Negative	$25.00
5-and-10-cent Store Props	3.00
Developing and printing	55.00
Transportation, odds and ends	14.00
	$97.00

IN LINE with a policy requiring that emphasis be placed on the most modern of mechanical subjects, it is fitting that this department in Modern Mechanics feature the latest and most important development in camera craft—amateur motion pictures. Experimenters in this field will find here an ever widening fund of information and helpful suggestions. In this issue the subject of amateur movie making is discussed in an introductory fashion, of chief interest to the beginner.

Getting a Start in Amateur Movies

FAR from being a rich man's pastime, the making of amateur motion pictures has now reached such a point of general popularity that the sport has its own class magazines, and dozens of manufacturers are competing for patronage in a race with innovations, novelties and striking improvements.

But the first question asked by the person contemplating taking up this new sport is—"how much."

A complete outfit of motion picture camera and projector can be had new for as low as $33, in the nine millimeter field, and from around $150 and up in the sixteen millimeter class. The difference in size may be visualized when it is remembered that regulation motion picture film, as used in theaters, is 35 millimeters, or one and three-eighths inches, in width. The smallest size is most popular abroad, while in this country the 16 mm. width leads in demand.

A financing plan has been worked out by many amateurs which offers an excellent practical solution to the cost problem. First a group of interested people get together and consider this proposal:

"Why not pool our camera money and get a movie outfit to be owned as club property?"

A little figuring with a pencil by one of the principal advocates will show that in this way the cost per person can be made very small.

The advantages are easy to see. Few individuals care to use their movie camera constantly. It would be sufficient for anyone's needs to have the camera in "fair weather rotation," leaving the outfit in turn with each member of the club. Special events, such as weddings and birthday parties, which fall on arbitrary dates, can be spoken for and arrangements made with the club director to obtain the camera at the desired date.

In practice, these clubs are found to work without friction, with many unexpected advantages. Some members of the clubs prove particularly efficient in shooting scenes, and lend their talents to less successful

This harness arrangement enables the motion picture camera to follow all the motions of a dancing couple. The camera is placed on casters and is swung about by the motions of the dancers. Lloyd Hughes and Mary Astor are shown in the machine.

members when a certain scene is wanted filmed. Expensive equipment such as full color attachments, telephoto lenses, and so on, can be obtained by the club where they would be out of reach of the average camera owner. Intelligently conducted, the amateur movie club can be a highly successful affair. As time goes on, club members may acquire cameras and outfits of their own, and sell their rights in the community outfit, though retaining membership. Perhaps some members will buy only a camera, using the club projector for their shows. Members of the same family may work the club idea to advantage, also. In some cases a camera owner finds that he can rent his outfit to others and cut down the cost of his purchase.

HOME MOVIES IN COLORS REALIZED BY INVENTION

ONE of the most important developments in amateur motion pictures is the recent perfection of the Eastman "Kodacolor," placing colored movies in the reach of the home movie maker.

Attachments have been manufactured for their Cine-Kodak and projector consisting of a color filter which does not interfere with the making of regular black and white motion pictures.

An ingenious system of embossing the back of the base of the film with tiny cylindrical lenses brought about the achievement. These lenses, in combination with the Kodacolor filter and the special panchromatic emulsion that coats the film, result in a full color film that brings to the home screen all the natural colors in full brilliancy, without requiring the actual coloring of the film itself.

Only black and white duplicate films can be made at the present time, and as yet the Eastman plant at Rochester is the only station operating for Kodacolor. The Cine-Kodak, model B with f. I. 9 lens is already adapted for color filming, but other models of their cameras and projectors require some alterations before using the new color process.

KEYHOLE MATTES PROVIDE COMEDY TOUCH FOR AMATEUR

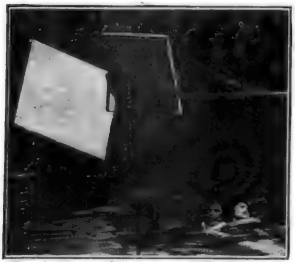
A NOVEL effect often used by professional camera men has been placed within reach of the amateur by Bell and Howell, who have put on the market a

series of vignetting mattes to fit their Filmo camera.

These mattes are made in the shapes of hearts, keyholes, triangles and binoculars. Much fun can be had by slipping the keyhole vignette over the lens to put a comedy touch on a kissing scene. For horse races the binocular matte adds a note of realism to the amateur's reel. A vision matte can also be obtained for taking double exposures where the camera man wants to show his subject having a dream, and similar effects. Duplicate mattes fit over the finders.

An iris vignetter for Filmos enables the amateur to get the much desired "circle-in" and "circle-out" effects. Bell and Howell make this vignetter for use with one inch f. 3. 5. lens in either fixed or focusing mount.

HOME MADE REFLECTORS



Showing how reflectors are used in the movies

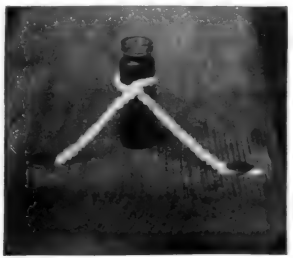
A HOLD-OVER from still camera habits is the idea most amateur movie makers have that the sun should be behind the cameraman.

In making movies the opposite is true—shooting is done toward the sun, only with care being taken to shield the lens from the direct rays.

This position does away with the harsh lights and shadows on the subject's face, provides pretty effects in the hair because of backlighting, and prevents the operator's shadow from showing in the foreground.

But reflectors are an important adjunct in shooting against the sun, and full use of them should be made. By holding a reflector on the shadow side of the subject, or in front, a diffused light is obtained that brings out the features. A sheet of white cardboard tacked on a frame provides a fairly durable reflector. If nothing else, use a sheet thrown over a chair, or hold up a large mirror to reflect the light at a proper angle.

SMALL BOTTLE HOLDER FOR THE AMATEUR'S DARK ROOM



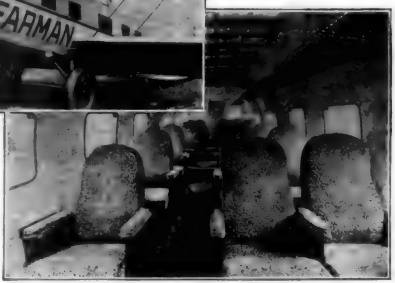
When using small bottles of acid or other fluids in the dark room, a very handy and clever holder can be made for them as shown in the photo. Bend an ordinary smoking-pipe cleaner strip evenly over the bottle and make one snug twist. Fasten the ends of the cleaner strip under two small thumb tacks. This is a handy little scheme around the bench when using acids taken drop by drop from the bottle with a swab or small glass dropper. There is no danger of upsetting the bottle.

PATHEX INCREASES LIBRARY FOR HOME FILM SHOWS

Pathex, manufacturers of 9 millimeter outfits, has issued a new list of exhibition films which can be shown on their home projectors. The list includes such film notables as Will Rogers, Harold Lloyd, Doug Fairbanks, and Lillian Gish. Current lists of their releases for amateur movie makers can be obtained from them by writing Pathex, 35 West 45th street, New York.

Giant Air Liner Has Novel Features

Carrying 18 passengers, this immense new passenger plane is powered with two four-bladed propellers instead of the conventional two-bladed type.



The interior of this new biplane accommodates 18 passengers and presents much the same appearance as a luxurious railway coach. The "bug eyes" in the streamline nose of the plane, shown above, are adjustable searchlights. Note the engine radiators incorporated in the struts anchoring the upper wing to the fuselage.

SEVERAL new features of airplane design are incorporated in the huge de luxe passenger plane recently completed at the Farman Works in Paris. The ship is powered by twin engines under the upper wing. Instead of the usual two-bladed propeller, the four-bladed type is used. This makes it possible to reduce the diameter of the blade, which permits the engine to be mounted over the cabin, yet close enough to the fuselage so that efficiency is not sacrificed.

To cut down wind resistance, the nose is streamlined and the landing gear built close to the lower wing. Radiators built into the wing struts further minimize resistance. Twin searchlights, resembling human eyeballs in appearance, furnish illumination for night landings. The pilot's cabin is entirely separate from that of the passengers.

Birds Show Way to Airplane Efficiency

BIRDS still hold all records for efficiency in flying, if not for speed. The average small bird does not travel faster than 25 miles an hour, while 200 miles is easily attained by airplane. But an enormous amount of energy is required to propel a plane at this speed. Birds travel almost effortlessly, floating to a large extent on unseen currents of the upper air.

A puzzling fact observed by scientists is that the larger birds have smaller wings, in proportion to their size, than their lesser brothers. The wings of insects are still larger in proportion to body size. A small bird can fly to his perch at full speed, but the eagle must flutter his wings and "put on the brakes" before he can alight.

It was through watching the action of birds in flight that the Wright brothers developed the first airplane.

Tractor Out-pulls Elephant in Tug-of-War

SEVENTY-TWO hundred pounds of elephant came in second best in a tug-of-war recently conducted between Ruth, a 30-year-old elephant, and a small tractor. Four legs proved to have less "pulling power" than the caterpillar treads of the tractor. The elephant is shown bracing herself just as the irresistible pull of the tractor began to carry her backward.

MEASURING GLASS EXPANSION

ALMOST all materials expand with heat and contract with cold. But glass expands so slightly that it has been almost impossible heretofore to measure it. In the making of glazed dishes it is very important to know how much the glazing will expand, because if it exceeds the expansion of the clay body underneath, "crazing" will result. The fine cracks all over the surface spoil fine pottery.

Recently the Bureau of Standards devised a new method of measuring the expansion of glass to a very fine degree. Pieces of glazing only seven one-thousandths of an inch were measured, about three times the diameter of a hair. By using light waves as measuring beams, the expansion of as little as one two-hundred-thousandth of an inch was recorded. This is equivalent to a human hair expanding one four-hundredth of its diameter.

HE'LL GET THERE SHORTLY

THE "condensed" automobile shown below looks as if it had accidentally wandered into a stamping press and come out with the short edge of the argument. It was built for cross-country touring by Felix Vervoort of Trinidad, Colo. There is just enough room for the owner and his dog, and when garage accommodations are crowded, the machine is almost small enough to park in a bathtub.

—Ewing Galloway.

Old Ford parts were used in the construction of this abbreviated automobile.

How to Pick the Right Spark Plug for Your Car

Do you know why your automobile must use a particular type of spark plug to operate efficiently? This article tells you why your motor must use spark plugs adapted for its special use.

SPARK plugs are adopted for automobiles by the car manufacturers after extensive tests. While it is quite true that there are other plugs which will perform nicely in place of those furnished with the car, the standard equipment is not a bad choice for replacement. If plugs are to be purchased for the car it is well to have in mind certain definite points of information.

The type of plug is easily determined. They are separable in that they may be taken apart for cleaning, or they are non-separable and may not be taken apart.

In the illustration presented herewith the separable plugs and parts are shown at A, B, C, D, and the non-separable plugs are shown at E, F, and G.

Thread sizes and forms determine the size of the plug. The Ford is the one half-inch plug having the threaded portion the same size and form as the half-inch pipe thread. It is tapered thread and binds tighter as it is screwed into the cylinder head, thus forming the seal. The complete plug appears at A. At B the porcelain with the packing gaskets appears while at D the gaskets have been removed. The packing nut appears at the top of C while the lower view at C is of the spark plug body. The threaded portion is called the barrel. A plug may have a long body, (part above the threaded portion) or a long barrel (the part below the hexagonal body).

The plugs appearing at E and F are of the popular S. A. E.-18 size. At G the metric plug is shown. This plug is popular with the manufacturer of the small cylinder engine because of the fact that it requires less room. Plugs of the form of those shown at E, F, and G are sealed to the cylinder head by means of a compression gasket, one of which appears on E.

The style of the plug as intimated above has to do with the body form and the barrel form. If the engine has a spark plug pocket recessed in it the body will need be of a certain size and length or no wrench

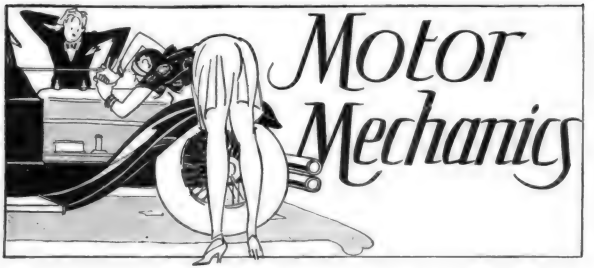
can be found which will place or remove the plug. If the cylinder head is such as to call for a long barrel the short barrel will not perform satisfactorily.

When ordering plugs first have in mind the type, separable or non-separable. Next have in mind the thread, as they are not interchangeable. They must be either half-inch, seven-eighth inch, or metric. Finally they are of the standard form, long body or long barrel.

WORN BEARINGS REBUILT

Machinery parts so badly worn as to be useless for further service can be reclaimed by building up the worn areas with a thickness of nickel electro-deposited on the original surface, using a special process developed by an English engineering firm.

The tough, ductile nickel deposit interlocks with the metal to which it is applied so that it becomes a part of the piece, and cannot be stripped off as in ordinary nickel deposition. By applying the special process to a worn bearing, the surface can be built up and machined off to any desired dimensions.

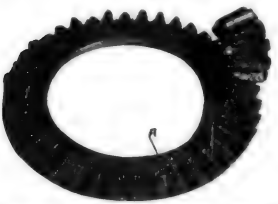


Conducted by RAY F. KUNS

Mr. Kuns is a well-known authority on automobile mechanics, being director of the Automotive Trade School of Cincinnati, Ohio. In this department of Modern Mechanics magazine Mr. Kuns will give monthly hints to the car owner on how to keep his automobile in the best of condition at minimum cost, and will point out how to avoid the commonest sources of unnecessary car expense.

"What Is That Bump I Hear?"

WELL, it may be any one of a number of things. Most often it is a piece of foreign material wedged between the teeth of the ring gear or the pinion gear, usually the ring. A case of this is shown in the picture reproduced herewith. This little piece of steel shown at A has been polished bright by the teeth of the pinion gear as they have been riding over it. Every time one of them hit it, a bump was telegraphed to the transmission of the car and from there it is a short distance indeed to the ear of the driver. Sometimes the knock or bump is telegraphed to the front end of the car until the driver is willing to declare under oath that the noise comes from a connecting rod or loose bearing.

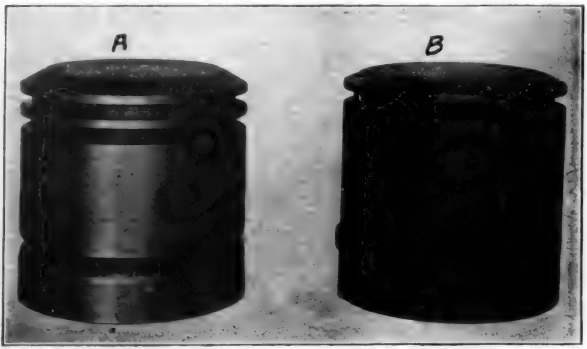


A piece broken from the pinion tooth is wedged between the ring gear teeth at A, causing noise.

If there is any question as to the source of the noise it can easily be determined. See whether it occurs when the engine is idling and the car standing, or when the car is coasting with the engine dead and the car out of gear. If it occurs in the latter case it can not be in the engine or transmission.

The remedy of course is plain—a new set of gears must be installed in the rear axle. It is best to install both ring and pinion. If one is damaged they are both certain to be strained. Many companies will not sell one without the other. They are run in together in the "quiet room" of the factory and are known to be right before they come to you. Use the utmost care in handling and installing them.

How Rust Destroys Cars Exposed to Weather



Piston A is in perfect condition. Piston B is rusted from standing with water in the cylinder.

EVERY season literally thousands of cars are thrown on the market which have been standing for months and months without use. Not so long ago cars were better cared for then they are at present. With the tremendous number of cheap cars available, it stands to reason that there are many of them sadly neglected. This would not be so bad if they were junked, as they should be. However, when the demand comes for used cars, many "junkers" are hauled out and "dolled up" and sold.

The two pistons shown in the picture tell the whole story. The piston marked A is in the condition that a piston should be, in order to give service. The one marked B was taken from an engine which had stood for a year without any care whatever. The piston is badly rusted and corroded. The top ring has been removed, but the second ring is rusted tightly into the piston.

Imagine the task of putting this engine in condition for real service. Money invested in a car of this kind is only so much money thrown away.

Ford Transmission Wrench

A WRENCH designed for use in removing and replacing Ford transmission bands has been perfected by Herbert Petterson, of McGregor, Iowa. The diagram illustrates its construction. The wrench is turned by the hand without the necessity of reaching into the transmission. It will remove the lock nut and washer on the reverse and brake pedals and eliminates all danger of dropping them into the transmission housing, entailing several hours of labor in recovering them. If desired, the shaft can be disengaged and the socket turned by hand. The wrench is provided with an opening in the center of the socket to permit the pedal adjusting shaft to pass through.

How Overheating *Ruins* Your Motor

HOW often have motorists heard this remark or a similar one, "You ought to have seen her boil coming up the hill, but then, she is used to it and it won't hurt her." Such remarks as these only go to prove the old statement that "ignorance is bliss." The piston and top ring shown in the accompanying picture give ample proof of this. It will be noted that the ring at point A has been very badly warped by the excess heat. Once it was out of the groove, it was impossible to get it back. The scoring at points B B, resulting in loss of power, also show the fallacy of the theory that there is no harm in a little overheating.

Cylinder walls are also damaged by overheating, and when walls and pistons are badly scored the only satisfactory remedy is to have the cylinders rebored and new pistons installed. An overheated engine is likely to require costly repairs.

Overheating has ruined this piston. Note warping of ring at A and scoring of piston at B B.

BATTERY TERMINAL PULLER

CORRODED battery terminals are hard to pull when, as often happens, the clamp bolt nut is corroded too and refuses to answer to the wrench. Any welder or garage man can make the puller shown here in a few minutes. The base is a piece of spring tip ground to the form desired. The upright is made from a piece of ½" cold rolled steel. This is welded to the base and then a brace of ¼" material is set in and welded. The hand screw which is made from a bolt and a piece of ⅛" iron is run through a nut welded to the bent over end of the post. The puller shown has been used to pull some of the hard ones, even without loosening the badly corroded clamp bolt.

BATTERY REJUVENATOR

Dry cells may be made to function when they are worn out by placing them in an oven for a few minutes. The added warmth stimulates chemical activity and will enable the user to get a few more hours of service. This is valuable when, as for instance on a holiday, no new batteries can be purchased.

If a hot knife is forced through the tar on top of the batteries, and vinegar poured into the opening, the acid in the vinegar will also give a new lease of life to the cell.

ANTI-KNOCK ACTION EXPLAINED

If you have been running your automobile with gasoline treated with tetra-ethyl lead, you will be interested in the latest theories of scientists explaining the action of this compound in taking the knock out of your engine. The less voltatile elements of the gasoline are thought to break up into minute liquid droplets when the charge is drawn into the cylinder. The tetra-ethyl lead is decomposed by the heat of the combustion chamber and the lead particles become concentrated on the droplets, which are thus prevented from exploding too soon.

Observation Body for Motor Car

Passengers can watch the scenery through the rear door of this observation motor car.

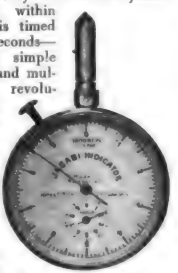
IS THE motor car passing through a cycle of body design which will eventually restore to popularity the old-time type of coach in which passengers entered the tonneau from the rear of the car?

An observation sedan body has been designed for American manufacture which has a reversible rear seat that permits passengers to face either forward or backward when riding. Entrance is gained through a door that opens just over the gas tank. Glass panels on all sides afford a clear view from every angle.

From the front the car presents the appearance of a conventional sedan. The body can be adapted to any chassis.

CLOCKLESS REVOLUTION INDICATOR

A NEW revolution indicator which gives absolutely accurate results without the use of a separate timing device has been put on the market by an American jobber. The mechanism within the instrument is timed to run three seconds—no longer. By simple mental division and multiplication the revolutions per minute are easily arrived at.



The secret of this mechanism lies in the use of a fine screw connected to a centrifugal governing wheel. When the thread is run out the instrument ceases to read. It is a great help to mechanics.

MILLIONS CHARGED TO AUTOMOBILES

That the total cost of automobiles is not represented by purchase price and upkeep expense is shown by a recent government report which lists the number of auto injuries in the United States in 1926 as 700,000, entailing an economic loss by deaths and injuries of $638,000,000.

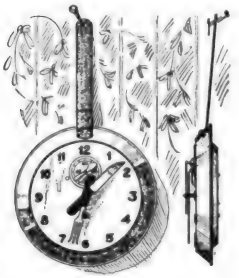
MOTOR WHEEL FOR CHEAP TRANSPORTATION

POWERED by a motorcycle engine and operated through the conventional handlebar control, a rubber-tired motor wheel has been invented which is claimed to represent the ideal in cheap and rapid transportation. The device is so simple that a youngster can operate it. The large wheel is fitted with a continuous inner track along which run a series of flanged wheels on which the mechanism revolves. The rider is seated inside the wheel on a regulation motorcycle saddle.

This new motor wheel is powered by a motorcycle engine running on a continuous steel track.

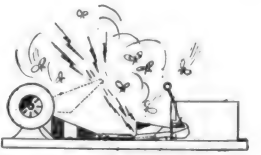
PATENTS NUTTY *or* NOVEL?

Here are patents granted for machines which it is hoped will advance the sum total of human welfare. They perform a variety of functions, from pulling the feathers off a chicken to murdering flies with electricity.



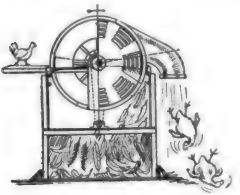
CLOCK OR FRYING-PAN?

Here is an ingenious collection of kitchen utensils arranged in the form of a clock designed to be hung in the living-rooms of gourmands to remind them of the approach of the dinner hour. It ought to work if the dish doesn't take a notion to run away with the spoon.



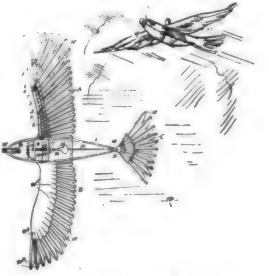
WHAT WILL A WATT KILL?

This is an electrical device for entertaining flies and giving them the thrill of a lifetime. For instance, suppose a few of the buzzy tribe are discovered in this trap by a housefly as he sails around a corner of the machine in retreat from his latest raid. Other flies, previously blown into the trap by an electric fan, inveigle him into entering their midst. As the fly warily walks toward his fellow racketeers, he rounds "death corner." An automatic device gives him the "works" and he dies like a dog, frozen stiff with kilowatts. Thus vengeance is done!



SQUAW-W-WK!

What chance has a little red hen in this thing? Designed to whisk the feathers off, this machine has a big wheel with teeth in it, and in the exact words of the patent specification, "a non-rotating member adjacent to the said body designed to co-operate with said body" and pluck out the feathers therefrom. This warlike engine would make any chicken blush. Imagine the embarrassment of a hen upon emerging from a treatment!



MAKING THE BIRDS JEALOUS

The inventor of this airplane has put Icarus, the first bird-man, to shame. Here we have a plane designed after the lines of a bird. Imagine the predicament of the aviator when his plane starts shedding feathers in the moulting season!

Penniless INVENTOR *Gets*

Anatol Josepho is shown above with his million dollar photo machine, which delivers 8 pictures in 8 minutes, all for 25 cents.

By ORVILLE H. KNEEN

BEGINNING in 1888 with the first crude gum-dispenser, hundreds of different steel-encased, gear-spring, lever-plus salesmen have been invented, down to the latest which pleasantly says "thank you" as it digests your nickel. But until a few short months ago the very idea of automatic portraiture seemed absurd. Certainly anyone

Million for Photo Machine

Ten years ago a penniless prisoner of the Bolsheviks; today an American millionaire! This fascinating story tells how a young Russian inventor persevered through years of discouragement and finally perfected a machine for taking automatic photos which he sold for a million dollars.

familiar with the complicated and highly technical process of adjusting the light, posing a trembling sitter, waiting for an elusive smile or appearance of sanity, developing and fixing plate or film, and finally making recognizable prints, would be the last to turn the job over to machinery.

Whether the admitted complication discouraged inventors, or whether their ingenuity was baffled, it is a fact that until a certain Russian immigrant landed in New York, short on dollars but long on ideas, the hands that waved the little birdie and pressed the bulb still pictured the nation's beauty and chivalry.

The inventor of the Photomaton, Anatol Josepho, could do that, too, but for fourteen years of war-buffeting and wandering, he had firmly believed that machinery could do it better.

As we see it now, the important thing was that Josepho knew photography first, and mechanics second. It is a great deal easier to generate ideas than to make them work, or to know beyond question that they are worth the trouble of making them work. When Josepho told his own tale of those long years when life itself was a daily gamble, I felt that his story could not fail to inspire every discouraged inventor.

No Films Used in Photomaton

Perhaps the most interesting part of the indomitable little Russian's machine is his method of direct photography on the paper. Much of the complication of photography comes from the use of glass plates or film. Josepho uses specially sensitized paper. Two inches of this are exposed at each snap of the

This shows the type of picture taken by the Photomaton, with Presidential Candidate Al Smith as the sitter. Eight photos for 25 cents!

—P & A Photo.

Henry Morgenthau, president of the Photomaton company, is shown above dedicating the first machine. He is a former United States Ambassador to Turkey.

shutter, while the sitter thinks pleasantly of sweetheart, friends, foreign travels or similarly cheerful subjects. In just 20 seconds his eight poses have been recorded, and he has but eight minutes to idle while the machine does the rest. Five 400-watt projection lamps, well placed, give just the right light on the subject.

An eighth-horsepower motor hums merrily. The strip is cut from a roll which will suffice for 800 more patrons. The exposed strip is fed by rollers into a 9-compartment tank, where it is quickly developed, "blanched," cleared and toned, with a thorough washing between each process. Electric drying finishes the job, and the sitter is handed a strip faithfully recording his looks, such as they may be.

Every photographer, amateur or professional, is surprised at the simplicity and effectiveness of Josepho's direct-photography. The paper is treated with a sensitive emulsion, in which are millions of microscopic particles of silver compound. The light rays from the sitter affect the particles, and when the paper is passed through the developer, those most affected are blackest, forming a negative similar to that usually made on transparent film or plate. Dark objects show up white, and all white objects are dark colored.

After a washing, the "negative" now passes into a powerful solution called "blanchite." This dissolves all the black silver away, leaving the silver-compound image. After washing and "clearing" in another solution, the picture is a distinct but faint positive. Compartment No. 8 contains "sepitone," which changes the pure white silver compound into a dark brown or black silver, and the strip of pictures is clear and complete, with every shading and item of detail as in ordinary photography.

Your Photo for 3⅓ Cents!

Anatol Josepho's amazing success, first in solving highly intricate problems in photography and mechanics, and second in interesting capital in his idea, proves anew the opportunities awaiting the practical inventor. He realized that it was not enough to have a new idea, or even to devise a working model of a machine designed to replace human hands.

From experience he knew the human being's craving, among all races and all lands, for a permanent record of his face. Josepho's photographic life had likewise taught him the constant demand for utilitarian portraits —for identification cards of all kinds, passports, employment records, expression-study, groups, and so on.

Thus, long before he was 32 and had received his "first million" all in one check, he knew that there was a place for a machine which would take pictures while the sitter was "off-guard," develop them swiftly, and hand them over at 3½ cents each. The success of the Pho-*tom*-aton (accent on the *tom*, please) is attested by the rapid installation of 120 machines in this country, Great Britain, South Africa, Shanghai and other lands. But it took Josepho some three years of unremitting work, not the least arduous being the trips from financier to capitalist to financier, before he had a machine and a capitalist who could see the profit in taking the "scare" and most of the cost out of portraits.

As an official of the company pointed out to me, Josepho early appreciated the advantage of eight views from which to choose.

Commercially successful! This picture shows the Photomaton installed in a department store. A large percentage of the sitters are "repeat" customers.

A department for making enlargements is being installed by some of the large department stores in New York City, where the automatic portrait machine is enormously popular, it is said, with buyers of new hats, new furs, and new "bobs" as well as garments.

"I was born in the central part of Siberia," Joseph told me. "I attended grammar schools, and later studied at the Institute of Engineering at Omsk. There I became interested in photography. To continue my studies in this field I scraped up enough money to go to Berlin.

"But my money soon ran low. I opened a photographic studio, and later moved to Budapest. My studio there made me a living while I experimented. When the World War broke out I attempted to return to Russia. I was caught at the border and interned under strict military surveillance.

"During the long idle days I conceived the idea of an automatic camera. In the extreme disorder following the Armistice I again tried to escape to my native land, but was imprisoned. For weeks I despaired. But then I found that most valuable of assets— a friend.

Risking Death for Freedom

"We managed to bribe a Hungarian officer. From him we secured forged documents and Hungarian uniforms. On a dark night we scaled the prison camp's barbed-wire walls, dodged the sentries, and a few hours later boarded a troop-train bound for Odessa. There we exchanged our uniforms for those of Russian prisoners.

"But the Revolution was under way. As we began to work our way across Bolshevik Russia, we were stopped and thrown into prison once more. But we had risked our lives too often by that time to be deterred. Three nights later we took advantage of a heavy storm and tried another escape. The alarm was given, and our lives hung in the balance as we fought our way past two guards.

"In the nick of time we reached the protecting forests. For eighteen days we traveled only at night. Nearing our homes, we grew careless and traveled by day. We thought our ragged condition would save us, but a second time the Bolsheviks picked us up as suspects and we were herded into a prison at Tchellisbinsk.

"Finally we interested an officer. He swung open the prison doors, even provided us with railroad passes. My friend and I parted, not to meet until years later, in a foreign land of promise. I went to Harbin, in Manchuria, and made money by buying goods in China and selling later at a high profit. But one day, while I was on the train, bandits took all my money. Once again I was penniless. But the thought of the automatic camera was always haunting me.

"I went to Shanghai and opened a photograph studio. There I took pictures of the

English colony and the slant-eyed Chinese, while I worked out the details of my invention. By 1923 all I needed was money, and some delicate parts such as optical apparatus. I knew I could get them in America. Like all Europeans I had heard of the fortunes to be made there. So I sold my studio and sailed to San Francisco. For months I wandered about the country, arriving in New York with thirty dollars.

A Check for a Million

"The next year was hard. Many times I found myself down to my last dollar. I sought friends willing to sink a few dollars in making a working model and getting patents. I knew it would revolutionize the making of portraits. At last some New York business man gave me enough to open a studio on Broadway. Six months' trial was to prove whether the invention on which I had staked so much for fourteen years, was wanted by the public.

"We soon found out. Two thousand persons a day lined up at the studio and their quarters flowed into the slots. The Broadway crowds proved that my rapid-fire picture machine was a gold-mine. I will never forget the meeting where Mr. Henry Morgenthau, who you know was once ambassador to Turkey, handed me a check for one million dollars for my interest in the Photomaton camera.

"This proved to me how generous American business men can be. I am now able to work on other ideas I have, to make the necessities and luxuries of life available to every one."

One unexpected result of the immigrant's success, apart from making him an American citizen, is the trust fund he has established to help other inventors. Out of this timely aid may come some of the great inventions on which tomorrow's progress, comfort and happiness will depend.

Thus the self-portrait machine of a penniless photographer may hasten the age of the slot-machine salesman. As human hands become increasingly expensive for purely mechanical work, Josepho and his million doubtless will replace them with steel-faced salesmen of everything from shoes to hats, from balloon tires to new limousines, and automatic portraits of ourselves in the chauffeur's seat. If only Josepho and his inventor-friends could make us a coin-operated greenback machine, and "nickelodeons" that yield bright new nickels instead of devouring them!

WEEDS DESTROYED BY RAILROAD SPRAY MACHINE

A WEED-KILLING spray machine which has recently been designed for railway use is unique in its ability to deliver uniform quantities of chemicals on the roadbed regardless of the speed with which the spray car is traveling. This is accomplished by a self-measuring positive pressure pump driven from the axle of the car, where it is always on the job ready for action the moment the train moves. The weed-killing chemicals are contained in a tank car connected with the spraying machine by means of pipes. Railroads are required to keep their roadbeds free from weeds because of the fire menace they present in the late fall months.

—Courtesy Chipman Chem. Eng. Co.

Note operator's chair on rear of this flat car, used for spraying weeds on railroad right-of-way.

Conducted by **MAHMUD SINGH**

The editor of this department of Modern Mechanics magazine, Mahmud Singh, obtained his earliest education in Oriental magic in Delhi, India, where he was initiated into the brotherhood of wandering fakirs. What do you know about magic making? Mahmud Singh is always glad to hear from amateurs who have developed new ways of performing old tricks. Write to him in care of this magazine.

Mystery of the Disappearing Matches

ANOTHER simple after dinner trick is performed with a box of safety matches. The label of the box must have a heavy black line running around each end. A small black rubber band is slipped over this line and is of course invisible at a short distance.

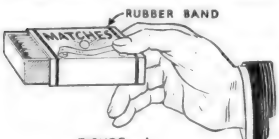


FIGURE 1

The performer announces that he will wrap up a few matches in a handkerchief and cause them to vanish. Holding the match box as shown in Fig. 1, he pushes the sliding box out of its cover with the first and second fingers. Taking out a few matches, the magician rolls the rubber band off the box and around his fingers, which are then curled inward to conceal the band.

The magic maker lays down the match box, picks up the handkerchief with his left hand and spreads it over the right. The right thumb is inserted under the rubber band as shown in the diagram. The left hand places the matches upright in the center of the handkerchief and the right hand grasps them from below. The handkerchief is turned over and the rubber band is slipped around the matches through the folds of the cloth.

The left hand grasps a corner of the handkerchief, shakes it, and of course fails to dislodge the matches. The handkerchief is empty—as far as the audience is aware.

An added dramatic effect is secured if the magic-maker conceals a second bundle of matches about his person, to be secured later and produced, apparently, from inside the coat of one of the spectators.

FIGURE 2

A Vanishing Ring Trick

THE amateur magician is frequently called upon at the conclusion of dinner parties to entertain the guests with a few samples from his bag of tricks. For such occasions it is well for the magic maker to have stocks of simple and effective illusions which can be presented using "props" to be found on the dinner table. One of the most effective illusions is the vanishing ring trick.

A specially prepared handkerchief is the only property carried by the performer. In the center of the handkerchief the two ends of a short thread are sewed, forming a loose loop. A cheap finger ring hangs from this loop.

The Empty Glass

A wine glass or similar shallow goblet is borrowed from the table, and also a napkin. One of the guests is asked to lend a ring for the trick, and the magician pretends to put it underneath the handkerchief. Instead, he grasps the ring on the loop from outside the handkerchief and conceals the borrowed ring between the tips of his thumb and first and second fingers.

The goblet is handed to a second guest who is requested to hold it with one hand while she grasps the handkerchief ring from outside the cloth with the other hand. The magician picks up the napkin by one corner and shows it to be empty. Then he gathers the corners together, forming a sack into which he drops the concealed ring. The napkin is handed to a third person with the request that he hold the corners tightly together.

The performer then orders the assistant holding the handkerchief over the goblet to drop the ring into the glass. This is done and the tinkle of the ring against the glass is plainly heard. The performer then taps the glass with a knife, lifts off the handkerchief, and shows the glass empty. The ring on the loop is hidden by the folds of the cloth.

The assistant holding the napkin is then asked to open it, producing the borrowed ring which is identified by its owner.

The Overflowing Rice Bowls

A TRICK which is very puzzling to observers is known to professional conjurors as the illusion of the Chinese rice bowls. Two empty bowls, previously shown to the audience, are placed on a table. One is fitted mouth down on top of the other, and on removing it a moment later the bowl is found to be overflowing with rice. The lower bowl is again covered, the magician adjusting it, and when separated once more the rice has disappeared and the bowl is overflowing with water.

Three bowls, identical with each other, are required for this trick. The edge of one of the bowls must be perfectly flat. This bowl is filled with water previous to the trick. Over its mouth is fitted a piece of transparent celluloid slightly larger than the circumference of the bowl. If the edge of the bowl is carefully moistened, it can be filled with water and the celluloid disc prevents the liquid from spilling out when turned upside down.

A large, stout manila bag filled with rice is another accessory. The bottom of the bag is dented in, forming a depression shown as "B" in Figure 3. It hides the

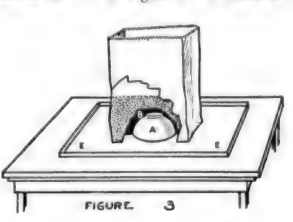


FIGURE 3

water filled bowl, shown as A. The bowl and its disc are inverted on the tray E, with a thin piece of wood or coin under one edge of the disc to keep it from direct contact with the tray. Unless the bowl is so

supported, there is danger that the disc might stick to the tray when the bowl is raised. A shelf at the back of the magician's table, sliding under it, completes the equipment.

The bag of rice, covering the water filled bowl, is standing on the tray at the begin-

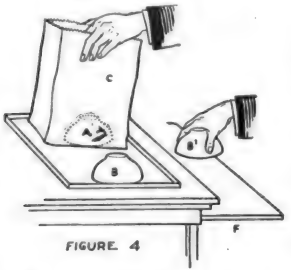


FIGURE 4

ning of the performance. The back of the tray is close to the edge of the table. The two bowls are shown to the audience and found to be without any preparation.

The performer then places one empty bowl alongside the bag, while he takes the other B^1 and apparently places it on the other side of the bag while he lifts the sack C, shown in Fig. 4. In reality he places bowl B^1 on the shelf F, behind the table, out of sight of the audience. The bowl which he seems to place on the tray is the water-filled bowl A which has been concealed under the bag. A little practice will enable the performer to carry off this deception perfectly if he remembers that the bag must be lifted at the same moment his hand is out of sight behind it.

The Inverted Bowls

The empty bowl on the tray is now filled with rice from the bag. The bowl is carefully leveled off so that the rice is even with the top. The water-filled bowl is next picked up and held mouth downward in a slightly slanting position so the audience can not see the disc. It is then placed on top of the rice-filled bowl, as shown in Fig. 5.

Taking up the two bowls, the performer reverses their positions and sets them on the table with the rice bowl uppermost. Slowly he lifts the top bowl and the rice spills out, giving the illusion that both containers are full of grain. The heap of rice in the lower bowl is then leveled off, giving the impression that it is still full of grain. Then, reversing the bowls once more, the disc is removed with the empty bowl and the bottom one shown to be full of water.

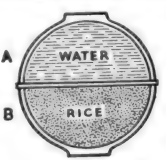


FIGURE 5

The effect is very impressive and inexplicable to the average audience.

The Leaping Coin

A VERY simple but effective illusion is that of the Leaping Coin. The performer attaches a length of hair or of fine black silk to the bottom button of his vest. To the other end of the thread is attached a bit of wax, which is anchored to another button of the vest. The magician borrows a small coin from a member of the audience and unobtrusively attaches the wax to the coin. Next, borrowing a drinking glass, he holds it with his left hand and drops the coin into it.

Carefully swinging the glass in short circles, to give the impression that the movement has something to do with the success of the trick, the performer gradually shoves the glass farther away from him, until the invisible string secured to his vest starts to pull the coin up the side of the tumbler. When it reaches the top of the glass the wax is removed and the coin returned to its owner.

Killing Cotton Plant Pests *with* Smoke

POISONOUS smoke is the latest weapon employed by science in fighting the destructive boll weevil, which annually costs Southern farmers many millions of dollars through its attacks on cotton plants. A powder mixture is dropped into the hopper of the smoke spraying machine shown in the picture. This powder is fed into a fire box, where it is ignited, producing a heavy thick smoke. The smoke is directed through two pipes projecting down alongside the wheels, being driven by a chain-operated blower which scatters the fumes on the plants.

This machine is expected to save Southern cotton growers $300,000,000 a year through its use of poisonous smoke to destroy boll weevils.

When in operation a heavy canvas covering is built around the pipes to keep the fumes from sweeping up and overcoming horse and driver. The canvas also prevents the weevils from flying out of danger. The cost of protecting cotton in this manner is low, averaging only 20 cents an acre for materials.

The spraying machine shown in the photograph is an adaptation of the familiar Paris green sprayer used by farmers in destroying potato bugs.

Large plantation owners expect to adapt the smoke machine to airplane use so that large areas may be sprayed in a short time.

BOYS DRIVE TINY RACERS

A baby auto race in which the speed cars were boy-size reproductions of famous racing machines was recently held at a large Paris speedway. The cars were faithful imitations of regular models, even to pneumatic tires and small gasoline motors. They were built by the French automotive engineer, Buggatti. The race was witnessed by several other prominent French auto builders, who are shown standing back of the starting line.

AUTOMOBILES NOT POPULAR IN HOLLAND

There is a bicycle to every 2½ inhabitants in Holland, but automobiles have failed to win great popularity in the low country. Holland is a country without hills, and the popularity of the bicycle is attributed to this fact. Separate bicycle roads running parallel to the regular highways are provided by the authorities.

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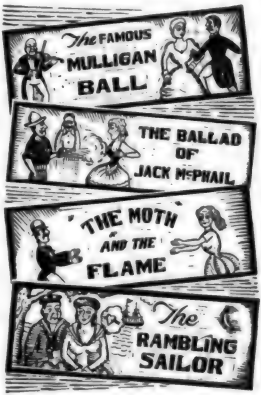

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November

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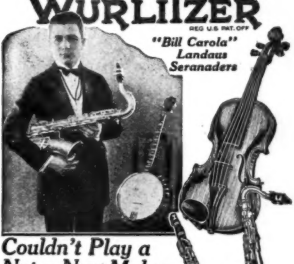

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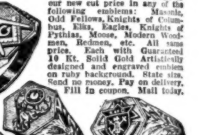

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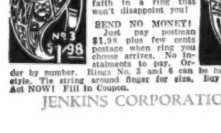

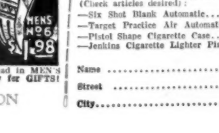

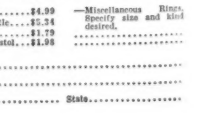

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